Real Exchange Rates Persistence in the West African Monetary Zone: A Revisit of the PPP Puzzle

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14 June 2015

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Abstract

The purchasing power parity (PPP) is important in the development of key theories in economics. The balance of payment and the portfolio-balance theories, for example, are developed on the notion that PPP exists. Also, key exchange rate and trade policies are formulated on the basis that PPP holds. As The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone propose to form a monetary union—the West African Monetary Zone (WAMZ), the validity of PPP is crucial to prevent member countries from gaining arbitrages by trading with one another. This paper examines whether the PPP holds for these countries using a mixture of time series techniques over varying sample periods. Consistent with some existing studies, we find the PPP not to hold for these countries, implying that the WAMZ agenda may face some challenges, since member countries can potentially gain from trade and investment arbitrages by trading with one another.

Key Words: Real Exchange Rates, Persistence, PPP Puzzle, WAMZ

JEL Classification: F31

June 2015

1. Introduction

The purchasing power (PPP) hypothesis has remained one of the widely discussed puzzles in international finance and economics literature. In its absolute form, the PPP hypothesis states that the real exchange rate between two countries is their relative price levels (see Cassel, 1918). In its relative form, the PPP hypothesis states that any change in the nominal spot exchange rate between two countries is the same as their inflation differentials (see Holmes, 2000). The reasons why the PPP hypothesis still continues to receive extensive limelight are clear. The assumption of a valid PPP has been central to the development of key theories such as the balance of payment theory, and the monetary and portfolio-balance theory (see Dornbusch, 1988; Chortareas and Kapetanios, 2009). In addition, most key exchange rate policies and trade reforms derive their recipes from the PPP theory (see Layton and Stark, 1990). To iterate the role of the PPP, particularly for developing countries, Holmes (2000) states that: (i) the PPP become a forecasting model for exchange rates and a benchmark for identifying under- and overvaluation of currencies; (ii) majority of exchange rate theories precede on the notion of PPP.

Contributing to the role of PPP hypothesis, Kargbo (2004) argued that the PPP doctrine has been central to the wide-ranging exchange rate and the general economic reforms that have been pursued by most countries in Africa post-1980. Liu and Burkett (1995) emphasized that the effectiveness of these reforms hinges on the validity of the PPP hypothesis. In spite of the remarkable policy implications of the validity of the PPP hypothesis, the existing findings in the literature are conflicting (see among others, Kravis and Lipsey, 1978; Krugman, 1978; Hakkio, 1986; Giovannini, 1988; Taylor, 1988; McNown and Wallace, 1989; Liu, 1992; Rogers and Jenkins, 1995; Holmes, 2000; Pedroni, 2001; Kargbo, 2004; Lopez et al., 2005; Bahmani-Oskooee et al., 2007; Wallace, 2008). To be more specific, whereas some studies (see Kravis and

Lipsey, 1978; Hakkio, 1986; Holmes, 2000) find the PPP hypothesis to be invalid, others (see Frenkel and Mussa, 1986; Grilli and Kaminsky, 1991; Diebold et al., 1991; Lothian and Taylor, 1995; Holmes, 2000; Kargbo, 2004; Lopez et al., 2005; Bahmani-Oskooee et al., 2007; Kim and Lima, 2010 and others) find the PPP hypothesis to be valid. The conflicting nature of these previous studies casts some doubt on the models and policy reforms developed on the notion of valid PPP.

The PPP, though widely studied in the literature, has been less-investigated for countries in Africa, particularly those in the West African Monetary Zone (WAMZ)[1]. Yet the trade and exchange rate reforms in this region are largely driven by PPP-based frameworks (see World Bank, 1996; Kargbo, 2003a). The representative studies of the PPP hypothesis in the WAMZ region include Adler and Lehman (1983), Madhavi and Zhou (1994), Nagayasu (1998), Salehizadeh and Taylor (1999), Holmes (2000), Odedokun (2000), Kargbo (2003a, 2003b, and 2004), Alagidede et al. (2008), and Baharumshah et al. (2010). As in studies on other countries, the findings from these representative studies are also conflicting.

The apparent mixed findings on the validity of PPP as documented by the previous studies for various countries are worrying. More so, there is less research done on the PPP hypothesis for countries of the WAMZ area as the literature shows. As argued elsewhere (see Alagidede et al., 2010), an important ingredient for pursuing a successful monetary union is a well-supported PPP which leaves no room for arbitrage gains from trade and investments between countries. The mixed findings documented by the few studies cast a dark shadow on the feasibility of the WAMZ area agenda. Further, since countries in the supposed WAMZ area have pursued PPP-

[1] On 20 April, 2000 six Heads of States met in Accra, Ghana, to sign an agreement to form a monetary zone known as the West African Monetary Zone (WAMZ) by the year 2003. The participating countries were The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone.

based trade and exchange rate reforms in the recent past, the conflicting findings coerce us to think whether these policies were relevant at all. The importance of the PPP doctrine; the conflicting conclusions in the literature; and the fact that it has been less-examined in the WAMZ case, makes the PPP hypothesis worthy to re-examine. Our aim, in this paper is to therefore shed a new light on the PPP hypothesis for countries in the WAMZ area. We focus on the WAMZ area since the framework is very new; thus, a study on countries in this suppose monetary zone will provide insight into what potential barriers might be encountered.

We proceed in the remaining sections as follows. In the next section, we take a look at the relevant representative studies on the WAMZ area. We discuss our methodology in section 3. In section 4, we present and discuss the empirical results. We then provide some concluding remarks in the final section.

2. The Representative Literature

The literature on the PPP hypothesis for the WAMZ area is still very limited. Nonetheless, the few available studies examine the PPP puzzle from different angles. Nagayasu (1998), for example, utilizes panel cointegration techniques and annual data on black market exchange rate and price series for 16 African countries which include The Gambia, Ghana, Nigeria, and Sierra Leone over the period 1981-1994. He finds support for long-run PPP for these countries. However, when Nagayasu (1998) applies time series cointegration techniques and the same dataset for these countries, the support for long-run PPP varnished. Holmes (2000) tests the validity of the PPP theory for 27 high inflation African economies including The Gambia, Ghana, Nigeria, and Sierra Leone for the period 1974—1997 using quarterly data on bilateral

real exchange rate between these countries and the US. Holmes employs the augmented Dickey-Fuller (ADF) and the Im-Pesaran-Shin (IPS) tests. He finds the ADF test to reject the PPP hypothesis for these countries and the IPS test to firmly support the PPP hypothesis for the entire sample.

Odedokun (2000) examines the PPP hypothesis for 35 countries in Africa which include The Gambia, Ghana, Liberia, Nigeria, and Sierra Leone using the Granger cointegration technique and a quarterly dataset on the official exchange rate and the CPI for the period 1980-1991. Odedokun subdivides his sample into countries in the Communauté Financière Africaine (CFA) zone and the non-CFA zone. He finds support for long-run PPP in 17 countries mostly belonging to the non-CFA zone including The Gambia, Ghana, Liberia, Nigeria, and Sierra Leone. The author finds half of the remaining 18 countries in which the long-run PPP is rejected to belong to the CFA zone.

Also, Kargbo (2003a) examines the validity of the PPP hypothesis for 30 countries in Africa including The Gambia, Ghana, Nigeria, and Sierra Leone. Using the Johansen cointegration technique and a dataset consisting of black market exchange rates and consumer price index (CPI) covering the period 1960—1997, Kargbo (2003a) finds strong support for the PPP hypothesis for these countries. Kargbo (2003b) again utilizes the Johansen cointegration technique to examine the validity of the PPP hypothesis in the long run for 25 countries in Africa including The Gambia, Ghana, Nigeria, and Sierra Leone. Using an annual dataset covering the period 1958—1997 on exchange rates and food price indices, Kargbo (2003b) finds strong support for the PPP hypothesis in the long run. In another study, Kargbo (2004) investigates the validity of the PPP hypothesis for 35 countries in Africa including The Gambia, Ghana, Nigeria, and Sierra Leone. Using an annual data on bilateral official exchange rates and CPI for the

period 1958—2002, and the Johansen cointegration technique, the author finds strong evidence in favour of the PPP hypothesis for these countries.

In a very recent study, Alagidede et al. (2008) investigate the validity of the PPP hypothesis in the WAMZ area using the Johansen cointegration technique and quarterly data spanning 1974Q1 to 2007Q1. The WAMZ countries included in their study are The Gambia, Ghana, Nigeria, and Sierra Leone. These authors document two findings. First, they find the real exchange rate to follow a random walk. Second, they find the nominal exchange rate and nominal price series to exhibit different speed of adjustment towards long-run PPP. In particular, they find the nominal exchange rate series to adjust faster than the nominal price series towards long-run PPP. Based on these findings, the authors argue that whether or not the WAMZ will succeed hinges on well-coordinated macroeconomic policies and the validity of the PPP to eliminate arbitrages from trade and investments.

Finally, Baharumshah et al. (2010) also study the long-run PPP hypothesis using panel data stationarity tests for 11 African countries which include Ghana and Nigeria. These authors utilize conventional panel data stationarity techniques, as well as a series-specific stationarity technique; the seemingly unrelated regressions augmented Dickey–Fuller (SURADF) proposed by Breuer et al. (2002), to examine the long-run PPP in these countries. Their dataset contains monthly real exchange rate series spanning the period 1980-2007. They find the long-run PPP to be supported in the 11 countries using the conventional panel unit root tests. However, the SURADF fails to support the long-run PPP for 5 countries which include Ghana and Nigeria. Thus, their findings are mixed.

3. Methodology

3.1 Theoretical and Empirical Model Specification

In its absolute form[2], the PPP theory suggests that identical baskets of goods and services will trade at identical prices, in the long run (see Cassel, 1918; Rogoff, 1996). If we assume that transaction costs and trade barriers, among other factors, are non-existent, the PPP theory (or hypothesis) posits that the real exchange rate between two countries is the same as the ratio of the price levels in the two countries. This means that we can formulate the PPP hypothesis in its absolute form as:

$$E_t = P_t / P_t^f \tag{1}$$

where E_t, P_t, and P_t^f are the real exchange rate, the domestic price level, and the foreign price level at time t, respectively. Equation (1) suggests, intuitively, that any price differential between trading countries will eventually be eliminated because the countries will take full advantage of arbitrage from trade associated with the price differentials. This adjustment mechanism ensures that the price levels are equalized in the long run between the trading countries.

It is important to note that the PPP hypothesis stated in absolute form [as in (1)] assumes that the *law of one price* (LOOP) holds. In other words, (1) is stated on the basis that transaction costs and trade barriers, among other factors, are negligible. However, the LOOP is a theoretical notion. In reality, commodity markets are not perfectly integrated, thus transaction costs and trade barriers are not negligible (see Dornbusch, 1988). Thus, it has been argued that a relative

[2] To distinguish the definition from other definitions such as the Relative PPP theory, the Efficient Market PPP theory, and the Generalized PPP theory.

form of the PPP hypothesis makes an intuitive logic. The relative form of the hypothesis can be expressed mathematically as:

$$RE_t = e_t P_t / P_t^f \quad (2)$$

where RE_t, e_t, P_t, and P_t^f are the real exchange rate, the nominal exchange rate, the domestic price level, and the foreign price level at time t, respectively; and e_t is the nominal exchange rate in the home country per the currency of the foreign country. The observed e_t is known to be influenced by factors such as trade impediments (i.e. tariffs and quotas), technological changes, transport and information costs, factor supplies, and differences in weighting schemes for price indices and consumption patterns in countries over time (see Kargbo, 2003a).

In the literature, different techniques have been employed to examine the validity of equation (2), the PPP hypothesis. We refer the interested reader to Rogoff (1996), Sarno and Taylor (2002), and Taylor and Taylor (2004) for excellent reviews of the PPP hypothesis. The earliest studies are mostly based on univariate regression techniques (see Isard, 1977; Kravis and Lipsey, 1978; Krugman, 1978; Hakkio, 1986; and Giovannini, 1988; for such examples). The generation which follows the univariate regression studies employs conditional variance techniques (see Engel, 1993; Rogers and Jenkins, 1995). The current generation relies on the variance ratio, unit root and cointegration tests to examine the PPP hypothesis (see Frenkel and Mussa, 1986; Grilli and Kaminsky, 1991; Diebold et al., 1991; Cheung and Lai, 1993; Kugler and Lenz, 1993; MacDonald, 1993; MacDonald and Marsh, 1994; Lothian and Taylor, 1995; and Pedroni, 2001; for older studies). The most recent tests of the PPP hypothesis based on unit root and cointegration techniques can be found in studies such as Kargbo (2004), Lopez et al. (2005),

Bahmani-Oskooee et al. (2006), Bahmani-Oskooee et al. (2007), Alagidede et al. (2008), Wallace (2008), and Baharumshah et al. (2010).

In this paper, we deploy the unit roots (or stationarity) approach to investigate the validity of the long-run PPP hypothesis for countries in the WAMZ area. The motivation for using this approach is quite straightforward. The unit root tests are very easy to implement in various statistical and econometric packages. That aside, the interpretation of the empirical results of unit root tests for the PPP hypothesis is relatively simple. In addition, unit root tests provide powerful tools for examining the persistence of macroeconomic variables than other techniques.

The idea behind the unit roots approach is to test whether (2) is stationary. If (2) is stationary, then the PPP hypothesis is said to hold for the country under consideration. We maintain the links between the theory and the empirical analysis by calculating RE_t in (2) from our data (i.e. $\widehat{RE}_t$), following three simple steps. First, we extract monthly nominal bilateral exchange rates between the countries in our sample and the USA. Second, we extract the consumer price index for each of the countries and the USA. Finally, we construct the real exchange rate in the form

$$ln\widehat{RE}_t = ln\left(\hat{e}_t\, \hat{P}_t / \hat{P}_t^f\right) \tag{3}$$

where $\hat{e}_t$, $\hat{P}_t$, $\hat{P}_t^f$ are the bilateral nominal exchange rate between the WAMZ country and the USA, the domestic price level of the WAMZ country, and the USA price level at time t, respectively, obtained from the data. ln denotes the natural logarithm of the real exchange rate series. We take the natural logarithm of the real exchange rate series to remove any outliers. This is in line with the international economics literature. The data on all the variables used to construct the bilateral exchange rate, (3), is obtained from the International Financial Statistics Database compiled by the IMF. All member countries in the WAMZ area are included in our

sample. They are The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone. The dataset has varying spans due to lack of data for some of the countries before the 2000s. The periods covered are: 1961M01-2015M01 for The Gambia; 1963M03-2015M03 for Ghana; 2004M01-2014M08 for Guinea; 2001M01-2014M11 for Liberia; 1960M01-2015M03 for Nigeria; and 2006M01-2015M02 for Sierra Leone.

3.2 Estimation Techniques for Testing Real Exchange Rate Persistence

As we have pointed out in section 3.1, we use unit roots or stationarity techniques to examine the persistence of real exchange rate (or the PPP hypothesis) in the WAMZ area in this paper. If the real exchange rate series contain unit roots, then the PPP hypothesis is rejected, implying that the real exchange rate series are persistent. The unit root approach employed in this paper is subdivided into unit roots tests with and without structural breaks. These tests are described briefly in the following subsections.

3.2.1 Unit Roots Tests without Structural Breaks

The unit roots tests without structural breaks employed here are the Dickey-Fuller Generalized Least Squares (DF-GLS) and the Ng-Perron tests, proposed by Elliot *et al.* (1996), and Ng and Perron (2001), respectively. We prefer these tests to the conventional ADF and PP tests because they are found to perform better when the underlying series has a large and negative moving average (MA) component (see Schwert, 1987; Caner and Killian, 2001). Indeed, some Monte Carlo studies have found the DF-GLS and the Ng-Perron tests have substantially higher power, even when the root of the time series is closer to unity (see Elliot *et al.* 1996; Ng and Perron,

2001). These two tests are discussed in various papers. So for space consideration, we discuss them briefly in this paper.

The DF-GLS and the Ng-Perron tests are developed from the following Dickey-Fuller regression

$$\Delta y_t = \alpha + \beta y_{t-1} + \delta t + \sum_{i=1}^{k} \rho_i \Delta y_{t-i} + \epsilon_t \quad (4)$$

The DF-GLS is performed on GLS-detrended data, unlike the Dickey-Fuller test. The DF-GLS tests the null hypothesis that $H_0: \beta = 0$ (i.e. y_t is non-stationary) against two possible alternatives: (i) y_t is stationary about a linear trend; and (ii) y_t is stationary with no linear trend and nonzero mean. The Ng-Perron test also uses GLS-detrended data and tests the same hypothesis but differs with the DF-GLS test in terms of the test statistics. Ng and Perron (2001) derived four test statistics which are modifications of Phillips-Perron statistics, the Bhargava (1986) statistic and the Elliot et al. (1996) Point Optimal statistic.

3.2.2 Unit Roots Tests with Structural Breaks

Macroeconomic time series often exhibit structural breaks. There are various reasons why such breaks may occur. These include, among others, oil price shocks, business cycles, drought, natural disasters, wars, technical progress, and sudden discovery of natural resources. Structural breaks can distort the statistical power of the unit roots or stationarity tests we have discussed above. Perron (1989), for example, finds these tests to accept the null hypothesis of unit roots in time series, even when there are clear indications of no unit roots. Since Perron (1989) identified this weakness, various stationarity tests have been developed to take into account structural breaks in time series. These tests can be categorized into unit roots tests with single and multiple

structural breaks. Each of these categories are considered in this paper. The reason we use all of these unit roots tests is to provide evidence that have stronger intuitive appeal.

For the unit roots tests with single structural break, we use the Perron test proposed by Perron (1997), and the Zivot-Andrews test proposed by Zivot and Andrews (1992). For the unit roots test with multiple structural breaks, we use the KSS test proposed by Kapetanios, Shin and Snell (2003). These tests are able to detect structural breaks in the transition parameter of the time series process.

The Perron test, which was originally derived by Perron (1989) and later modified by Perron (1997), proceeds by fitting the following Augmented Dickey-Fuller (ADF) regression with shifts in mean and trend

$$\Delta y_t = \alpha + \beta y_{t-1} + \sum_{i=1}^{k} \rho_i \Delta y_{t-i} + \mu_t + \epsilon_t \tag{5}$$

where $\mu_t = \mu_0 + \mu_0^s d_{tTB} + \mu_1 t + \mu_1^s (t - T_B) d_{tTB}$ are potential deterministic terms, and T_B is the break date. The test has three null hypotheses: (i) y_t is non-stationary with a structural break in the intercept; (ii) y_t is non-stationary with a structural break in the trend; and (iii) y_t is non-stationary with a structural break in both the intercept and trend.

Zivot and Andrews (1992) argue that the Perron test suffers because the break date is exogenously determined. They argue that the identification of a break date may be unassociated with the data. Thus, if the critical values computed under the null hypothesis are computed on the basis that the break date is determine *ex ante*, then there can be substantial size distortions. Under this kind of situation, the Perron test will frequently reject the null hypothesis of unit root. The Zivot-Andrews test differs from the Perron test by explicitly modeling the break date

endogenously. The Zivot-Andrews test also uses the ADF regression in equation (5). The test applies the Perron (1989) procedure for each break date in the dataset, and selects the break date for which the support for the null hypothesis is strongest (see Zivot and Andrews, 1992). The null hypotheses under the Zivot-Andrews test are the same as those under the Perron test.

Recent studies have shown that macroeconomic variables can contain more than one structural break. In such cases, the Zivot-Andrews and Perron tests may underperform. Kapetanios, Shin and Snell (2003) have advanced an exponential smooth transition autoregressive based stationarity test which takes into account multiple structural breaks in a series. Their test (hereinafter, known as the KSS test) is developed to detect the presence of unit root against a nonlinear globally stationary exponential smooth transition autoregressive (ESTAR) process of the form

$$\Delta y_t = \gamma y_{t-1}\{1 - \exp(-\theta y_{t-1}^2)\} + \varepsilon_t \qquad (6)$$

where Δ is the first difference operator, y_t is the time series variable being tested, γ is a coefficient, $\theta \geq 0$ is the transition parameter of the ESTAR model, t is the time period, and ε_t is the white-noise error term.

The hypothesis of interest is stated such that $\theta = 0$ implies y_t is a non-stationary linear process against the alternative of $\theta > 0$, which implies y_t is a stationary nonlinear ESTAR process. γ is said to be unidentified under the null hypothesis of linear unit root. Thus, Kapetanios *et al.* (2003) compute a first-order Taylor series approximation to the ESTAR model under the null hypothesis of $\theta = 0$ and derive a *t*-type test statistic, following Luukkonen *et al.* (1988). Equation (1) becomes the following auxiliary regression

$$\Delta y_t = \delta y_{t-1}^3 + \varepsilon_t \quad (7)$$

With some extension to (6) for a general case of serially correlated errors, Kapetanios *et al.* (2003) arrive at the general auxiliary regression for (7) in the form

$$\Delta y_t = \sum_{j=1}^{p} \rho_j \Delta y_{t-1} + \delta y_{t-1}^3 + \varepsilon_t \quad (8)$$

where p is the optimal lag to be included in the regression using AIC or BIC, and ρ_j and δ are coefficients to be estimated. The hypotheses are then formulated such that $\delta = 0$ implies unit root against $\delta < 0$ implies nonlinear stationary ESTAR process. The *t-type* statistic obtain for δ (i.e. $t_{NL} = \hat{\delta}/se(\hat{\delta})$) can then be compared to the simulated critical values for the three different cases tabulated by Kapetanios *et al.* (2003, Table 1, p. 364).

4. Empirical Results

4.1 Basic Description of the Real Exchange Rate Series in the WAMZ

We construct the real exchange rate using bilateral nominal exchange rates between the WAMZ member countries and the USA; and the consumer price indices of these countries and the USA. We construct the real exchange rate as $ln\widehat{RE}_t = ln\left(\hat{e}_t \hat{P}_t/\hat{P}_t^f\right)$, where $\hat{e}_t$, $\hat{P}_t$, $\hat{P}_t^f$ are the bilateral nominal exchange rate between the WAMZ country and the USA, the domestic price level of the WAMZ country, and the USA price level at time t, respectively, obtained from the International Financial Statistics Database hosted by the IMF. As mentioned earlier, we take the natural logarithm of the real exchange rate to moderate outlier-effects in the empirical analysis. ln denotes the natural logarithm of the real exchange rate series. Though the multilateral exchange

rate offers better interpretation of trade competitiveness between these countries and their trade partners, we employ the bilateral real exchange rate because data on multilateral real exchange rates for the WAMZ member countries is very limited.

Table 1 shows the descriptive statistics of the bilateral real exchange rate for each of the WAMZ member countries in our sample. The Jarque-Bera test has rejected the null hypothesis that the real exchange rate series are normally distributed at conventional levels of significance. Non-normality of the real exchange rate distribution for each of these countries is further supported by the Skewness and Kurtosis statistics. The statistics show that the real exchange rate is negatively skewed in the case of Ghana, Guinea, Liberia, and Sierra Leone; and positively skewed in the case of The Gambia and Nigeria. The skewness, though, in each of these countries is moderate. The Kurtosis statistics show that the real exchange rate has non-Gaussian peaks. The shape of the real exchange rate distribution is more peaked than the Gaussian distribution for each of these countries with Guinea and Liberia proving to have higher "peakness" than the other countries. The real exchange rate also exhibits some deviations. The standard deviation ranges from 0.42 in Liberia to approximately 7.34 in Ghana. Since the sample periods are varying, we must be careful about the comparisons here.

A better picture of the real exchange rate trends in this region is shown in Figure 1 in the appendix. The real exchange rate series in Figure 1 displays an upward trend in each of the countries in the sample. The graphs show that The Gambia, Ghana and Nigeria had moderately stable real exchange rates during the 1960s and the 1970s. This is not surprising since these countries were operating fixed exchange rate regimes during these periods. From 2000M01 to 2006M07, Guinea experience a steady increment in its real exchange rate; then for a brief period, 2006M07 to 2007M03, the real exchange rate declined rapidly, indicating a sharp structural

break in the trend. The exchange rate in Liberia exhibits irregular pattern between 2001M01 and 2004M01, also portraying some structural breaks in the trend (see Figure 1 in the appendix).

Table 1: Descriptive Statistics

Statistic	Gambia	Ghana	Guinea	Liberia	Nigeria	Sierra Leone
Mean	0.855	-8.774	8.347	3.965	-1.161	8.219
Median	1.222	-7.277	8.355	3.928	-2.421	8.293
Maximum	4.001	1.779	9.314	4.724	5.639	8.910
Minimum	-1.470	-19.002	6.529	3.006	-5.667	7.546
Std. Dev.	1.810	7.337	0.771	0.423	4.331	0.447
Skewness	0.154	-0.122	-0.710	-0.087	0.316	-0.156
Kurtosis	1.433	1.417	2.759	2.042	1.377	1.466
Jarque-Bera	68.936	66.790	11.067	6.602	83.800	11.232
Probability	[0.000]	[0.000]	[0.004]	[0.037]	[0.000]	[0.004]
Sum	554.699	-5483.695	1068.420	662.084	-769.824	904.074
Sum Sq. Dev.	2123.935	33595.290	75.538	29.741	12419.950	21.749
Observations	649	625	128	167	663	110

Note: Std. Dev. and Sum Sq. Dev. denote, respectively, standard deviation and sum of squared deviations.

4.2 Empirical Evidence of Real Exchange Rate Persistence in the WAMZ

The popular way to examine the persistence of macroeconomic variables is through unit roots tests. This paper employs various unit roots tests to examine the persistence of real exchange rates or the PPP hypothesis in the WAMZ area. One of the earliest techniques used for examining persistence or unit roots in time series is the variance ratio test which was popularized by Cochrane (1988), and Lo and MacKinlay (1988; 1989). We first present the results of the overlapping variance ratio test proposed by Lo and MacKinlay (1988; 1989) in Table 2. Then we follow by presenting the results for the main unit roots tests that we have discussed. The overlapping variance ratio test captures the long autocorrelations crucial for producing

stationarity. The null hypothesis under the overlapping variance ratio statistic states that the real exchange rate is generated by a random walk process. If the overlapping variance ratio equals unity, then the real exchange rate is said to follow a random walk process. On the contrary, if the overlapping variance ratio is less than unity, then the real exchange rate is stationary or mean-reverting. In Table 2, we find the variance ratio test to reject the null hypothesis that the real exchange rate is generated by a random walk process at conventional levels of significance in all the countries, except Liberia. Thus, following this approach, we can easily say that the real exchange rate is only persistent in Liberia or the PPP hypothesis is supported in all the countries except Liberia. The main drawback here is that the overlapping variance ratio test can be distorted by significant breaks in the real exchange rate series in these countries. The implication is that any conclusion at this point can be misleading.

We extend our analysis by considering unit roots tests without structural breaks. Here, we employ the DF-GLS and the Ng-Perron tests. Since trending is a crucial attribute of the real exchange rate series in our dataset, we perform these tests by considering drift and trend options. The empirical results are displayed in Table 2. The DF-GLS and the Ng-Perron tests fail to reject the null hypothesis of unit root in the real exchange rate series at the conventional levels in all the countries. The implication is that the PPP hypothesis is rejected or the real exchange rate series is persistent and non-mean reverting. Similar to the overlapping variance ratio test, the presence of structural breaks can distort the power of the DF-GLS and the Ng-Perron tests. Hence, the results reported by these tests may also be misleading. To cater for structural breaks, we deplore unit roots tests with structural breaks. There are those unit roots tests which can only deal with single structural breaks. These are the Perron and Zivot-Andrews tests. The Perron and the Zivot-Andrews are very similar in that we can perform these tests by choosing either the

trend or drift options or both. The results of these tests are reported in Table 2. The results for unit roots tests with single structural breaks strongly suggest that the real exchange rate series is persistent in the WAMZ area at the conventional levels, if we ignore the Perron and the Zivot-Andrews tests with the drift term for Ghana. This implies that the PPP hypothesis is rejected. Thus, the real exchange series is persistent in these countries.

Unit roots tests with single structural break, as we have pointed out elsewhere in this paper, suffer when the observed breaks are two or more. So the results obtain so far are not conclusive. We take this analysis further by considering a unit roots test which can contain at least two breaks. This test is the Kapetanios et al. (2003) test. The results for the KSS test are reported in Table 2. This test fails to reject the null hypothesis of unit roots in the data generating process of the real exchange rate series at the conventional levels of significance in all the countries, except Ghana. Thus, the real exchange rate series are said to be persistent or the PPP hypothesis is rejected (see Table 2). Our findings are generally consistent with the findings documented in Nagayasu (1998), Holmes (2000), and Baharumsah et al. (2010).[3] Yet, our findings diverge with the findings of Odedokun (2000), Kargbo (2003a,b; 2004), and Alagidede et al. (2008).

[3] These authors employ time series and panel techniques in their papers. Our findings only support their findings which are based on time series techniques.

Table 2: Test of Real exchange Rate Persistence in the WAMZ Area

	Gambia	Ghana	Guinea	Liberia	Nigeria	Sierra Leone
Main Tests			**Statistic**			
Variance Ratio	3.907***	4.724***	2.852**	2.087	3.759***	6.069***
DF-GLS [Drift]	1.887(12)	3.109(7)	0.951(1)	1.318(12)	2.572(11)	0.691(3)
DF-GLS [Trend]	-1.029(12)	-0.980(5)	-1.426(1)	-1.892(11)	-0.607(3)	-1.468(2)
Ng-Perron [Drift]	1.621(12)	1.338(7)	0.848(1)	1.268(12)	1.539(11)	1.116(3)
Ng-Perron [Trend]	-2.645(12)	-2.060(5)	-4.511(1)	-7.809(11)	-0.834(3)	-5.089(2)
Perron [Drift]	-4.104[1985M07]	-5.693[1983M07]**	-2.969[2012M11]	-4.535[2009M03]	-4.373[1986M04]	-4.094[2009M05]
Perron[Trend]	-2.404[2005M10]	-2.576[1999M08]	-3.820[2006M01]	-3.257[2005M02]	-2.059[2006M12]	-3.127[2013M08]
Zivot-Andrews[Drift]	-4.098[1985M08]	-5.698[1983M08]***	-2.981[2012M11]	-4.582[2009M03]	-4.386[1986M05]	-4.524[2009M06]
Zivot-Andrews[Trend]	-4.653[1985M08]	-2.836[1997M02]	-3.465[2007M02]	-4.878[2004M05]	-2.102[2006M12]	-2.811[2011M04]
KSS	1.692	-2.603**	2.053	2.567	-0.251	2.553
Other Tests			**Statistic**			
Shapiro-Wilk	0.859***	0.871***	0.917***	0.964***	0.812***	0.892***
BDS	0.364***	0.680***	0.633***	0.612***	0.671***	0.672***
Chow	3708.933[1985M07]***	3149.373[1983M07]***	166.382[2007M07]***	472.767[2009M03]***	2732.727[1986M04]***	419.104[2009M05]***
Bai-Perron	[1976M05]	[1977M02]	[2005M08]	[2004M07]	1975M09	[2007M05]
	[1986M03]	[1984M11]	[2008M04]	[2008M05]	1983M12	[2010M01]
	[2002M04]	[1996M01]	[2010M11]	[2012M05]	1992M03	[2013M11]
	[N/A]	[2003M10]	[2012M06]	[N/A]	2000M06	[N/A]
ARCH-Effects	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}

Note: *** and ** denote significance at 1% and 5%, respectively. Items in the block, round and curly parentheses denote, respectively, the break date, selected lag and p-value.

5. Concluding Remarks

The idea of purchasing power parity (PPP) plays important role in the development of key theories in economics. For instance, the balance of payment and the portfolio-balance theories rely heavily on the existence of PPP (see Dornbusch, 1988; Chortareas and Kapetanios, 2009). In addition, some key exchange rate and trade policies are formulated on the basis that PPP holds (see Layton and Stark, 1990; Holmes, 2000). Most African countries have been recipients of PPP-based general economic and exchange rate reforms, especially post-1980 (see Kargbo, 2004). Amongst these reforms are the World Bank and IMF sponsored the Economic Recovery and the Structural Adjustment Programmes which were implemented in majority of the sub-Saharan African countries. However, the validity of the PPP doctrine is now in doubt, implying that these policy reforms may have been poorly devised (see Liu and Burket, 1995). One other aspect where PPP doctrine comes handy is the formation of a monetary union. Six countries, namely: The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone signed a treaty on 20 April, 2000 to form a new monetary union to be known as the West African Monetary Zone (WAMZ) by the year 2003. Yet, as Alagidede et al. (2010) argue, the success of such a monetary union hinges on a valid PPP in order that member countries cannot gain from arbitrages by trading with one another. So far the literature on the PPP doctrine documented for the countries in the WAMZ is still very limited. In spite of this, the few ones arrives at divergent conclusions. Our contribution is therefore to shed a new insight into the PPP doctrine for these countries. We use alternative econometric techniques to document more convincing results. In particular, we use: the overlapping variance ratio test; the Ng-Perron and DF-GLS tests; the Perron and Zivot-Andrews tests; and the Kapetanios-Shin-Snell test and a dataset for real exchange rate series spanning different periods to examine the real exchange rate persistence for these WAMZ

countries. Consistent with some existing findings (see Nagayasu, 1998; Holmes, 2000; and Baharumsah et al., 2010), we find the PPP doctrine not to hold for these countries. Thus, the real exchange rate in these countries is persistent. The policy implication is that the WAMZ agenda may take a while to be realised since countries can still gain from trade and investment arbitrages by trading with one another.

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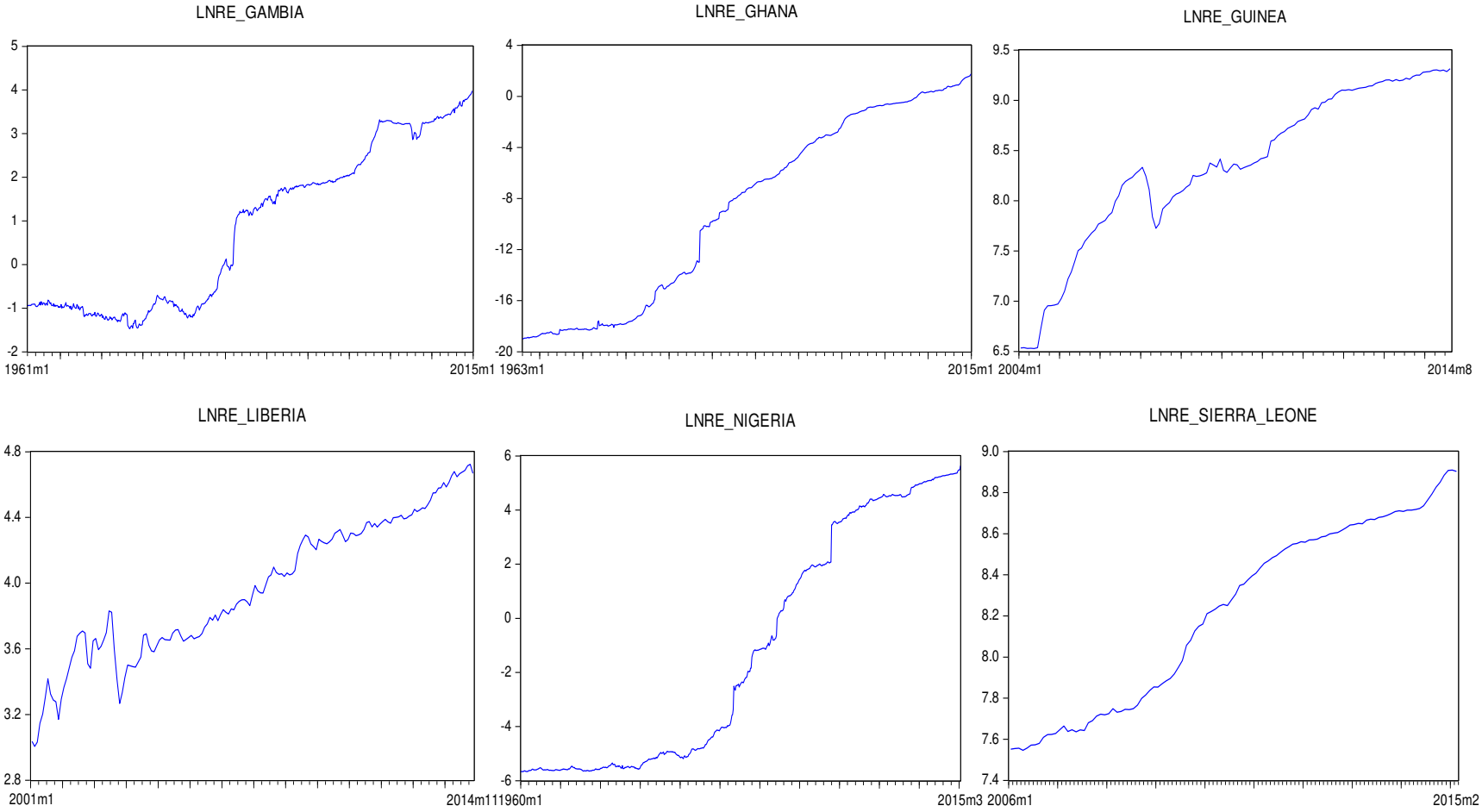
Appendix

Figure 1: Plot of Real Exchange Rate Series of Member Countries of the West African Monetary Zone



Note: LNRE denotes the natural logarithm of the real exchange rate