International Review of Economics and Finance 19 (2010) 755–768

Contents lists available at ScienceDirect

International Review of Economics and Finance

journal homepage: www.elsevier.com/locate/iref

# Cointegration, dynamic structure, and the validity of purchasing power parity in African countries

Augustine C. Arize [a,*], John Malindretos [b,1], Kiseok Nam [b,2]

[a] College of Business and Technology, Texas A&M University-Commerce, PO Box 3011, Commerce, TX 75429-3011, United States
[b] Sy Syms School of Business, Yeshiva University, New York, NY 10033-3201, United States

ARTICLE INFO

*Article history:*
Received 5 February 2009
Received in revised form 24 February 2010
Accepted 6 April 2010
Available online 24 April 2010

*JEL classification:*
C12
C22
F31
F41

*Keywords:*
PPP
Real exchange rate
Econometric analysis

ABSTRACT

The purpose of this paper is to test the validity of the purchasing power parity (PPP) in Africa in the context of a multivariate error-correction model. This approach allows for the consideration of long-run elasticities as well as the dynamics of the short-run adjustment of exchange rates to changes in domestic and foreign prices. Monthly data for fourteen African countries are used, and the period examined is 1973:4 through 2007:7 (i.e., 412 observations). Results from long-run cointegration analysis, short-run error correction models, persistence profile analysis and variance decomposition all confirm the validity of PPP in these moderate-to-high inflation countries, where estimates of half-life deviations from PPP are found to be outside the range suggested by Rogoff (1996).

Published by Elsevier Inc.

## 1. Introduction

The theory of purchasing power parity (PPP) is one of the most important relationships in international finance. It postulates a stable long-run relationship between the exchange rate of two currencies and the price levels of the countries involved. Because of the importance of PPP as the cornerstone of many exchange rate determination models,[3] as an equilibrium exchange rate relation by itself and as reference in policy decisions, testing PPP has continued to attract the attention of many researchers, but with mixed results.

While there is general consensus that PPP does not explain short-run exchange rate dynamics (Frenkel, 1981), whether or not such a relationship holds in the long run, however, has become controversial in the literature. On the one hand, studies such as Cushman (2008), Serletis and Zimonopoulos (1997) and Crowder (1996) have presented evidence that tends not to support the

* Corresponding author. Tel.: +1 903 886 5691; fax: +1 903 886 5693.
*E-mail addresses:* Chuck_Arize@tamu-commerce.edu (A.C. Arize), Malindre@ye.edu (J. Malindretos), Knam@yu.edu (K. Nam).
[1] Tel.: +1 212 960 0843.
[2] Tel.: +1 212 960 5400.

[3] Examples of exchange rate models that assume PPP holds are the sticky-price models of Dornbusch (1976), the flexible-price monetary models of Johnson (1976) and the asset pricing models of Lucas (1982). For more recent published studies on PPP, see for example, Sarno and Taylor (2002), Taylor (2006), the special issues on PPP and exchange rate behavior in special issue *Applied Financial Economics* (2006), and special issue, *Applied Economics Letters* (2009); and Kargbo (2003a,b, 2004, 2006, 2008, 2009a,b).

1059-0560/$ – see front matter. Published by Elsevier Inc.
doi:10.1016/j.iref.2010.04.004

long-run PPP.[4] On the other hand, Cheung and Lai (1993) and Cheung, Lai, and Bergman (2004) and Johansen and Juselius (1992) have suggested that PPP is valid in the long run.[5]

Earlier studies of PPP that have included some African countries in their sample have employed the conventional econometric methods such as ordinary least squares (OLS) and the *F*-test statistic, or a serial correlation test statistic. See, for example, Roll (1979), Adler and Lehmann (1983), Ojameruaye (1990), Tsikata (1998) and Subramanian (1998), which have provided mixed results. Recent research in the unit-root literature has shown that earlier results may suffer from "spurious regression" problems because they employed non-stationary data. Following the Engle and Granger (1987) work, some studies on PPP have used the Augmented Dickey–Fuller (ADF) test statistic which relies on the analysis of the residuals from a level regression model (see for example, Odedokun, 2000). However, the ADF is said to have low power and often does not find evidence for long-run PPP in small samples.[6] Odedokun (2000) used quarterly data on official exchange rates and the consumer price index to test whether long-run PPP held in thirty-five African countries from 1980–1991, finding support for long-run PPP in seventeen out of thirty-five countries.

More recently, researchers have investigated the long-run PPP in Africa using panel cointegration methods. Nagayasu (1998) used panel cointegration tests on annual data for black market exchange rates (expressed in U.S. dollars) and the consumer price index in sixteen African countries from 1981–1994, finding support for the long-run PPP. However, the tests for unit root and cointegration using annual data for the individual countries failed to show support for the PPP hypothesis. Holmes (2000) found support for PPP when he applied panel unit-root tests to quarterly data for selected African countries from 1974–1997. His results for the individual countries were not supportive of the PPP hypothesis. Mixed results were obtained also by Hassanain (2004) using both panel unit-root tests as well as a nonlinear instrumental variable estimator. One possible shortcoming with using panel data in testing PPP is that the relation between the exchange rate and relative prices might be strong in some countries but weak in others, therefore resulting in misleading results. For more on this, see Sarno and Taylor (2002).

Studies by Kargbo (2003a,b, 2004, 2006) have examined the existence of PPP in Africa using both annual data and the Johansen cointegration method and found overwhelming support for the long-run PPP.[7] Our aim is to add to these new studies on PPP for Africa.

This study tests for the validity of the PPP hypothesis for fourteen African countries over the monthly period 1973 through 2007 by means of Johansen and Harris–Inder cointegration tests. The two cointegration test methods applied here are based on two different null hypotheses: absence of cointegration in the Johansen method and presence of cointegration in the Harris–Inder method (Arize, Osang, & Slottje, 2008). To our knowledge, no other study provides an investigation of PPP using Johansen/Harris–Inder cointegration tests and African countries monthly data. Unlike some previous studies, we do not mix fixed and flexible floating exchange era.

A second motivation for this study is that these studies for Africa have focused almost exclusively on the cointegration between exchange rate and relative prices. With the exception of studies by Kargbo as well as Hassanain mentioned above, the speed with which the exchange rate adjusts to its equilibrium value has not received a detailed treatment in the literature. In a policy sense, the short-run adjustment of exchange rates to changes in domestic and foreign prices is also frequently important. How quickly exchange rates respond to changes in domestic and foreign prices is important, both for understanding future effects that may occur as a result of changes in monetary or exchange rate policy and for interpreting recent events (Arize, 1997). The speed of mean reversion is usually summarized by the half-life, the time necessary for half the effects of a given shock to dissipate. Rogoff (1996) gives the consensus estimates of the real exchange rate half-life to be three to five years. Such estimates imply a slow convergence to equilibrium and a length of time that is too long to rationalize on the basis of monetary or financial factor, which should be the principal source of PPP deviation given the massive short-term volatility of real exchange rates. This is referred to as the PPP puzzle (see Sarno & Taylor, 2002: 83 for more on this).

The puzzling aspect to this stylized fact is that, if PPP deviations have a monetary source, then the half-life of these deviations should be no longer than the time it takes sticky goods prices and wages to adjust to such monetary shocks. However, if real shocks are the source of these persistent PPP deviations, then the real exchange rate should be much less volatile than the nominal exchange rate due to the relative frequency of such innovations. But Engel (1999) has demonstrated that real exchange rate volatility is essentially as high as that of nominal exchange rates. There can be many explanations for deviation from PPP: product differentiation, transportation costs and insurance costs relating to international trade of goods, transportation time, transaction costs in international currency arbitrage, tariffs and non-price trade barriers, non-traded goods, index number problems, price and wage rigidities, etc. Kargbo (2006) points out that the possible factors influencing the puzzle include the persistent productivity differential among countries, monopolistic market participants' pricing to market efforts, international consumption's smoothing of consumption goods, continuing trade costs and nominal rigidities.

[4] Rejection of the long-run PPP hypothesis implies that exchange rate follows a random-walk hypothesis and that it does not depend on relative prices. A possible explanation for the failure of PPP in some industrial countries may be associated with the fact that, although inflation has been relatively stable across countries, real shocks have dominated nominal shocks in shaping the behavior of exchange rates, resulting in a divergence between the paths followed by exchange rates and those followed by prices. Some have suggested that the failure to find cointegration between nominal exchange rates and prices may be due to the econometric methods employed in previous studies, for example, power deficiencies of the augmented Dickey–Fuller (ADF) tests, panel unit-root tests and effects of contemporaneous correlation when applying tests (Lothian & Taylor, 1996).

[5] Evidence favorable to PPP implies that the nominal exchange rate, when adjusted for inflation differentials, must be stationary or constant. Most studies attribute the efficacy of PPP to the ongoing economic conditions in industrial countries, which are generally similar in structure and macroeconomic policies, and to the high degree of interdependence, as well as mobility in capital, goods and services.

[6] Low power means that there is a high probability of accepting wrong null hypothesis of non-stationarity. The low power or high Type 2 error problem is generally associated with using small samples.

[7] In the case of developing countries empirical studies generally find support for long-run PPP. For example, the consensus in Anoruo, Braha, and Ahmad (2002) and Zurbruegg and Allsopp (2004) is that PPP held during the recent floating exchange rate period. However, there are also studies covering different groups of countries as well studies covering periods of short duration that report evidence inconsistent with long-run PPP (see Wang, 2000). For more recent studies, see the reference section of Aggarwal and Simmons (2006), Kargbo (2006) and Bahmani-OsKooee, Kutan, and Zhou (2009).