



# Long-run purchasing power parity with asymmetric adjustment: Further evidence from nine transition countries

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## ABSTRACT

In this study, we applied a threshold cointegration test to investigate the properties of asymmetric adjustment on long-run purchasing power parity (PPP) in nine transition countries between January 1995 and December 2008. Although there was strong evidence of long-run PPP for these nine transition countries (i.e., Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Russia), the adjustment mechanism was asymmetric. These results have important policy implications for the nine transition countries included in the study.

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## 1. Introduction

During the past several decades, considerable effort has been put into testing the validity of long-run purchasing power parity (hereafter, PPP) hypothesis because it has important policy implications in international finance. Long-run PPP is indicative of a long-run relationship between the nominal exchange rate and the domestic and foreign prices of a particular economy.<sup>1</sup> When PPP exists, it can be used to determine the equilibrium exchange rate. When the PPP hypothesis does not hold, however, the use of any monetary approach to determine the exchange rate is invalidated because a monetary approach necessitates that the PPP hypothesis holds true. According to Holmes (2001) and Sarno (2005), PPP is important to policymakers for several reasons. First, it can be used to predict the exchange rate and determine whether a currency is over- or undervalued, which is particularly important for less developed countries and countries experiencing large differences between domestic and foreign inflation rates. Secondly, the notion of PPP is used as the foundation on which many theories of exchange rate determination are built. Consequently,

the validity is important to policymakers in developing countries who base their adjustments on PPP. Thirdly, from a theoretical perspective, if PPP is not a valid long-run international parity condition, this casts doubts on the predictions of open-economy macroeconomics, which are based on the assumption of long-run PPP. Indeed, the implications of open-economy dynamic models are sensitive to the presence or absence of a unit root in the real exchange rate. Finally, estimates of PPP exchange rates are often used for practical purposes, such as determining the degree of misalignment of the nominal exchange rate and the appropriate policy response, the setting of exchange rate parities, and the international comparison of national income levels. The practical uses of the PPP concept and, in particular, the calculation of PPP exchange rates would obviously be of very limited use if PPP deviations contained a unit root.

Although some empirical evidence of long-run PPP for both developed countries and less-developed countries seems convincing, nothing has currently been proved to be conclusive. As for methodology, recent studies of long-run PPP have primarily utilized conventional unit root tests for real exchange rates and cointegration tests for the relationships between various measures of domestic and foreign prices as well as nominal exchange rates. The conclusions drawn from these studies of long-run PPP have primarily been based on linear tests of stationarity and/or cointegration. Because ample evidence in support of asymmetric reactions in key economic variables has been widely acknowledged in recent years, there is no reason to assume that the long-run PPP adjustment process toward equilibrium is always symmetric. Indeed, Madsen and Yang (1998) and Ramsey and Rothman (1996) have shown that economic

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<sup>1</sup> PPP can also be viewed as the international version of the “Law of One Price (LOOP)” (i.e., if two countries are engaging in free trade, arbitrage should make the purchasing powers of the two countries’ currencies equivalent). Therefore, economists generally believe that PPP should hold in the long run. For example, Rogoff (1996) expressed his strong belief in PPP (see Taylor and Taylor, 2004). PPP has been one of the key building blocks of many international macroeconomic models. For the recent developments and debates in this area, see Taylor and Taylor (2004).

variables, such as inflation rates, follow an asymmetric adjustment process. In addition, Balke and Fomby (1997) suggested that the power of linear cointegration tests was lower in an asymmetric adjustment process (i.e., the assumption of symmetric adjustment is likely to yield poor results when it comes to equilibrium relationships because conventional cointegration tests do not take asymmetric adjustments into account). Furthermore, Enders and Granger (1998) showed that the standard tests for unit root and cointegration all have lower power in the presence of misspecified dynamics. This is important because the linear relationship is inappropriate if prices are sticky in the downward, but not in the upward, direction. Madsen and Yang (1998) have provided evidence that prices are sticky in the downward direction, which means that real exchange rate adjustments are asymmetric. Other reasons for the asymmetric adjustment are the presence of transaction costs, which inhibit international goods arbitrage, and official intervention in the foreign exchange market, which may make the nominal exchange rate movements asymmetric (Obstfeld and Taylor, 1997; Sarno et al., 2004; Taylor, 2004; Taylor and Peel, 2000; Taylor and Sarno, 2001; Juvenal and Taylor, 2008).<sup>2</sup> Kilian and Taylor (2003) suggested that nonlinearity may arise from the heterogeneity of opinion in the foreign exchange market concerning the equilibrium level of the nominal exchange rate (i.e., as the nominal rate takes on more extreme values, a great degree of consensus develops concerning the appropriate direction of exchange rate movements, and traders act accordingly). All of these reports motivated us to use threshold (asymmetric) cointegration tests in our study. A number of studies have provided solid empirical evidence for the non-linear and/or asymmetric adjustment of the exchange rate in developed countries (Baum et al., 2001; Taylor et al., 2001; Enders and Dibooglu, 2001), the G-7 countries (Kilian and Taylor, 2003), the 17 OECD countries (Serletis and Gogas, 2000), the Middle East (Sarno, 2000), Asian economies (Enders and Chumrusphonlert, 2004), African countries (Chang et al., 2011), and oil-exporting countries (Chang and Liu, 2010).

We hope that our empirical study can significantly contribute to this field of research by using the threshold cointegration test of Enders and Siklos (2001) to determine whether long-run PPP exists in nine transition countries (i.e., Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Russia). All of these countries are European Union (EU) members except Russia. As Alba and Park (2005) and Bahmani-Oskooee et al. (2008) point out, it is important to test the validity of PPP for these countries for several reasons. First, measurements and comparisons of income across countries are usually based on PPP. If PPP does not hold, comparing income convergence among these countries and other EU countries may be misleading. Secondly, these countries are in the process of entering the euro zone; thus, they need an estimate of equilibrium exchange rates before permanently linking to the euro. If PPP holds for these countries, then PPP rates may be used as an equilibrium exchange rate measure to estimate the appropriate exchange rates between the national currencies and the euro. Finally, the failure of PPP to hold may indicate exchange rate misalignments. Overvaluation

of national currency relative to main trading partners will actually widen current account deficits and adversely affect the country's macroeconomic stability, which is a key precondition for entering the euro zone. Although empirical studies of similar design (using threshold cointegration tests) have previously been conducted for both Asian and African countries, these types of studies have not been performed for transition countries. Thus, the present study filled a gap in the literature. The present study found that long-run PPP held true in the nine transition countries examined, but the adjustment mechanism was asymmetric. Our empirical results have important policy implications for the nine transition countries considered.

The present empirical study was organized into several sections. Section 2 briefly reviews the previous literature on PPP in transition countries, and Section 3 presents the data that we used in the study. Section 4 briefly describes the threshold cointegration test of Enders and Siklos (2001), and Section 5 shows our empirical results. Section 6 presents some of the economic and policy implications from our findings, and Section 7 concludes the paper.

## 2. Review of relevant literature on purchasing power parity in transition countries

Although an enormous body of empirical work examining PPP exists, not many studies have focused on transition economies. Taylor and Sarno (2001) point out that the behavior of the real exchange rate in transition economies is one of the most important current issues facing applied macroeconomists and policymakers. This follows from the importance of the real exchange rate in establishing the degree of competitiveness of an economy and the confidence that the international financial markets place in economies in transition (Taylor and Sarno, 2001). Despite growing interest in PPP in transition economies over the past two decades, the empirical evidence for transition countries is far from being as comprehensive as it is for developed market economies, and the empirical validity of PPP remains a controversial and unsettled issue in transition countries. For example, Choudhry (1999) investigated the PPP between USA and Poland, Romania, Russia and Slovenia, and only provided evidence of relative PPP in Slovenia and Russia. In another study, Christev and Noorbakhsh (2000) examined six Central European countries (i.e., Bulgaria, the Czech Republic, Hungary, Poland, Romania, and Slovakia) between 1991 and 1998. They found moderate evidence of long-run equilibrium of prices and exchange rates, but conditions for the law of one price were violated. In addition, Barlow (2003) tested the PPP theory for the Czech Republic, Poland and Romania using Johansen cointegration tests, but the conclusions for the time period from 1994 to 2000 were mixed regarding different combinations of the exchange rates of selected countries. In a study of the Croatian economy, Payne et al. (2005) did not find any support for the PPP theory. Interestingly, Solakoglu (2006) used a panel approach and concluded that the PPP held for transition economies. Sideris (2006) performed a long-run PPP test for seventeen transition economies using a panel cointegration test. The analysis provided support for a long-run equilibrium, but the cointegrating vectors violated the symmetry and proportionality hypotheses suggested by PPP. In different sub-periods, which were characterized by different exchange rate regimes, Sideris (2008) examined the validity of PPP using cointegration and unit root tests. The results provided support for a weak PPP relationship, which turned out to be robust across different exchange rate regimes. Recently, Koukouritakis (2009) examined the validity of the PPP between the 12 new EU countries (i.e., Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia). Using the Johansen cointegration methodology and allowing for a structural break for the countries that joined the EU in May 2004, the study found that there was a long-run equilibrium relationship among the nominal exchange rate, the domestic prices and the foreign prices for

<sup>2</sup> According to Taylor and Sarno (2001), an intuitively appealing emerging theoretical literature on the nature of international goods arbitrage suggests that real exchange rate adjustment may arise in an inherently nonlinear fashion. At the simplest level, one can imagine arbitrage in a single, homogeneous traded good only becoming strong once arbitrage yielded sufficient profit to outweigh transport and other costs of arbitrage, such that deviations from the law of one price (LOOP) might be expected to switch abruptly from non-mean-reverting (when the deviation from the LOOP is smaller than the arbitrage costs) to mean-reverting (once the deviation is greater than the arbitrage costs). This would suggest that one might find evidence of threshold nonlinearity (i.e., a discrete switch from non-mean reversion to mean reversion at a certain distance from the equilibrium level) – when examining deviations from the LOOP using disaggregated data (Obstfeld and Taylor, 1997). The threshold autoregressive (TAR) model assumes that whenever the threshold is hit, instantaneous adjustment towards purchasing power parity occurs. Please see Balke and Fomby (1997) and, for an application, Obstfeld and Taylor (1997).

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