

Further on nonlinearity, persistence, and integration properties of real exchange rates

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Abstract

Integration, nonlinearity, and persistence dynamics of several quarterly US-Dollar-denominated real exchange rates are investigated by using new unit root tests, simulated p -values for linearity tests, estimation of smooth transition autoregressive (STAR) models, and simulation of autocorrelation functions. This paper uses a simulation-based approach to study covariance stationarity and persistence dynamics of the estimated models. Findings in the paper provide evidence of nonlinear mean reversion for several series albeit with some persistence. Results also reveal considerable variation in the degree of persistence and timing of switches across extreme regimes in ESTAR models between Euro and non-Euro area currencies. © 2007 Elsevier B.V. All rights reserved.

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1. Introduction

A weaker form of purchasing power parity (PPP) hypothesis implies that the time series of the nominal exchange rate (S_t) and the price ratio between the home and foreign country (P_t/P_t^*) should revert towards each other over time. The extant literature on PPP shows that there are prolonged periods in which the nominal exchange rate deviates from its PPP level. An excellent account of this literature can be found in [Sarno and Taylor \(2002\)](#). Motivated by the equilibrium models of exchange rate determination in the presence of transactions costs (i.e.

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Dumas, 1992; Sercu et al., 1995) several recent papers investigated the nonlinear dynamics in PPP relationship.¹ Among others, Taylor et al. (2001), Baum et al. (2001), Taylor (2001), and Dufrenot et al. (2008, 2006) empirically studied nonlinearity in real exchange rates. The main conclusion that arises from this literature is that real exchange rates are nonlinearly mean reverting and hence the well-known PPP puzzle can be reconciled with the findings from the estimated exponential smooth transition autoregressive (ESTAR) models. The current paper contributes to this recent literature by showing that the estimated ESTAR models can be characterized with autocorrelations that might suggest quite persistent dynamics in real exchange rates and hence caution should be exercised in evaluating the arguments that tend to suggest the reconciliation of the puzzle.

The arguments of aforementioned papers rely on the conjecture that estimated ESTAR models are stationary. To our best knowledge, no formal results are available in the econometrics literature that characterizes the conditions for stationarity in these models. This is especially true for the specifications used in the majority of the empirical literature under general errors processes (see, e.g., Kapetanios et al., 2003; Park and Shintani, 2005). Therefore there is a need to develop tools that can enhance our understanding of the issues relating to stationarity and persistence dynamics in estimated nonlinear models for real exchange rates. To this end, the current paper examines the nonlinearity in several quarterly real exchange rates over the floating period with a special emphasis on issues relating to stationarity and persistence in the context of ESTAR models.

First, I investigate integration properties of real exchange rates through several standard unit root tests, a stationarity test, and two newly developed unit root statistics in the context of ESTAR models. Next, I report considerable evidence that supports the well-established result in the recent literature that an ESTAR specification can characterize the nonlinear dynamics in real exchange rates. Lastly, I propose an approach that allows one to evaluate covariance stationarity and persistence of real exchange rates within the context of the estimated nonlinear ESTAR models. Autocorrelation functions are simulated by calibrating on the parameters of the estimated ESTAR models with errors drawn from the residuals. The simulated autocorrelation functions from the ESTAR models are then used to check if they are approximately time-invariant and decline over distances in time. Results from the proposed method suggest that for majority of real exchange rates, estimated ESTAR models are covariance stationary but have slowly decaying autocorrelations. Simulated median/average autocorrelation functions calibrated on the parameters of the estimated ESTAR models match considerably well the autocorrelation structure of real exchange rates. The findings of the paper imply that as established in the recent nonlinear literature, real exchange rates can be well characterized by a nonlinear mean-reverting ESTAR process albeit with considerable persistence. Results from simulations indicate that it is not quite clear how well controlling for nonlinearity in real exchange rates reconciles the empirical PPP puzzle. Findings suggest the need for practicing caution in interpreting findings from nonlinear real exchange rate models.

The rest of the paper is organized as follows. Section 2 presents the econometric methodology in detail, while Section 3 discusses our empirical findings on stationarity, nonlinearity, and persistence. Section 4 summarizes the key conclusions of the paper.

¹ In these models, transaction costs create a band of inaction within which international price differentials are not arbitrated away. Only the price differentials exceeding transaction costs are profitable to arbitrage away. Therefore, the presence of transactions costs leads to the notion of different regimes in real exchange rates.

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