



# The exchange rate and purchasing power parity: extending the theory and tests

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## Abstract

This paper analyzes the exchange rate in a “no-arbitrage” or “real business cycle” equilibrium model and provides empirical evidence for this model vis-a-vis PPP. Our contribution is to show, based on a generalization of the equilibrium model of exchange rates, that (i) the test equation linking the exchange rate to fundamentals should allow for international heterogeneity in time preferences and risk attitudes, as well as noise—that is, the model should not be tested as an exact relation; (ii) empirical work should use levels of variables rather than first differences; and (iii) tests on the existence of long-run relations should be complemented by test on the signs of the coefficients. Our empirical work shows that, as a long-run relation, the generalized model outperforms PPP; moreover, under the generalized model, quarterly deviations from the estimated long-term relation have a half-life of only four to five quarters.

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## 1. Introduction

In the last few years the empirical literature on Purchasing Power Parity (PPP) seems to have arrived at the consensus that real exchange rates tend toward PPP in the very long run. However, as described in Rogoff (1996), the slow rate of convergence to PPP, with deviations having a half life of about three to five years,

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remains a puzzle. A recent class of exchange rate models tries to explain this by relating the real exchange rate to real factors such as consumption, non-traded good, and imperfections in the real sector; see, for instance, Cheung, Chen and Fujii (2001); Head, Mattina and Smith (2002), and MacDonald and Ricci (2002). Our objective in this paper is to extend the existing models and add fresh empirical evidence to extant test of this mode.

Our contribution on the theoretical front is to extend the existing equilibrium models of the exchange rates, also called “no-arbitrage” and “real business cycle” models, to allow for state dependent utility functions, and more importantly, different rates of time-preference and risk aversion across countries and across time. On the empirical side, we find that (i) it is important that the test equation for the real exchange rate model allow for international heterogeneity in time preferences and in risk attitudes; also it should be realized that (unidentified) state variables are probably missing from the test equation, so the model should be tested as a noisy one rather than as an exact relation; (ii) empirical work should use levels of variables rather than first differences; (iii) tests on the existence of long-run relations should be complemented by tests on the signs of the coefficients; and, (iv) the specification of the regression equation used in the estimation stage should offer demonstrated advantages over alternatives, and the significance tests should not rely on asymptotic distributions. Our empirical results indicate as a long-run relation the generalized model outperforms PPP; moreover, under the generalized model, quarterly deviations from the estimated long-term relation have a half-life of only four to five quarters.

The rest of this introductory section provides a brief review of the theoretical foundations and available empirical results, and relates our work to the existing literature. The cornerstone of the equilibrium models of the exchange rates is the result that, under suitable assumptions, the real exchange rate is the ratio of the marginal utilities of real spending.<sup>1</sup> For instance, Stockman (1980) and Lucas (1982) study the exchange rate in a model of an endowment economy with frictionless markets, where the solution is of an “equilibrium” nature in the sense that it maximizes international aggregate utility. Dumas (1992) applies this equilibrium property of the exchange rate in his analysis of a one-good production economy where international trade in goods is costly<sup>2</sup> and where agents have constant and identical risk aversions and time preferences. Sercu, Uppal, and Van Hulle (1995) study an endowment-economy with shipping costs and obtain closed-form solutions rather than the numerical results of Dumas. Instead of using shipping costs to model countries as distinct economic entities, Backus and Smith (1993) derive

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<sup>1</sup> For a recent review of macroeconomic models of the exchange rate see Devereux (1997), Lane (2001), and Obstfeld and Rogoff (2000).

<sup>2</sup> Empirical support for the effects of shipment costs has been documented in Engel (1993), Rogers and Jenkins (1995), and Wei and Parsley (1995), who find that a significant proportion of the total variation in the real exchange rate arises from deviations from the Law of One Price (LOP). Also Engel and Rogers (1995) show that within-country deviations from LOP are much smaller than cross-country deviations.

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