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Real exchange rates and real interest rate differentials: A present value interpretation ☆

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ABSTRACT

Although the real exchange rate–real interest rate (RERI) relationship is central to most open economy macroeconomic models, empirical support for the relationship is generally found to be rather weak. In this paper we re-investigate the RERI relationship using bilateral US real exchange rate data spanning the period 1978–2007. Instead of testing one particular model, we build on Campbell and Shiller [1987. Cointegration tests of present-value models. Journal of Political Economy 95, 1062–1088] to propose a metric of the economic significance of the relationship. Our empirical results provide robust evidence that the RERI link is economically significant and that the real interest rate differential is a reasonable approximation of the expected rate of depreciation over longer horizons.

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1. Introduction

Many well-known exchange rate models highlight the role of the real interest rate differential as a key determinant of real exchange rates. For example, sticky price models (see Dornbusch, 1976; Mussa, 1984) and optimizing models (see, for example, Grilli and Roubini, 1992; Obstfeld and Rogoff, 1996) emphasize the effect of liquidity impulses on real interest rates and consequently the real exchange rate. This relationship is often summarized in the form of the real exchange rate–real interest rate (RERI) relationship.

However, despite its centrality to many open economy macro models, the empirical evidence on the RERI relationship is rather mixed. In this paper we revisit the RERI relationship and suggest a new way of testing it, based on the VAR-method of Campbell and Shiller (1987) for testing present-value models. Our results indicate that the real interest rate differential is a reasonable proxy for the expected real depreciation of the US dollar and can be interpreted as the transitory part of the real exchange rate. This empirical finding provides strong support for the results of Baxter (1994) and also of Edison and Pauls (1993) who have emphasized that the link between real exchange rates and real interest differentials is to be found in the business cycle domain, instead of lower frequencies.

Our way of casting the RERI relationship into an empirical model rests on the idea that the real interest rate differential is the sum of expected period-to-period changes in real exchange rates. In this context, the real interest rate differential can be interpreted as the spread variable in a present-value model in which the discount factor is known and

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equal to one.[1] This allows us to take the projection for the change in the real exchange rate from a bivariate VAR, consisting of the change in the real exchange rate and the real interest differential, and to correlate this projection with the real interest differential. We argue that this kind of test is much closer in spirit to the RERI relationship than many extant tests and it produces measures of long-run expected changes in the exchange rate which are highly correlated with real interest rate differentials.

In our analysis we study bilateral real exchange rates for the US vis-à-vis the other G7 countries: Canada, France, Germany, Italy, Japan and the UK. The sample period is 1978 quarter 2 to 2007 quarter 3. In common with most other applications of the VAR-based present value approach, we find that the cross-equation restrictions of the present-value model are statistically rejected. However, we note that this can be attributed to the time variability of the discount factor, rather than to a rejection of the RERI *per se*. Indeed, we suggest interpreting the RERI more broadly as a significant and positive relationship between expected real exchange rate changes and the real interest rate differential. We first present graphical evidence which indicates that this broader version of the RERI is strongly supported by the data and economically significant. A key aspect of our broader interpretation is that it does not amount to a test of a particular model but that it provides a taxonomy of the economic significance of the RERI by asking what fraction of the variability in interest rate differentials is explained by changes in the rate of expected depreciation. This fraction is high and significant for all pairs of exchange rates we consider. Our method can be thought of as a formalization of the approach advocated by Campbell (1986) who argued in the context of the permanent income hypothesis that '[...]models which are strongly rejected statistically may be good approximations of the behavior of economic variables' (p. 29).

We further illustrate the empirical relevance of the RERI by investigating how various structural shocks affect the relationship. While doing so sheds light on the RERI as a *conditional* relationship, we also view this as a way to collect a set of stylized facts on the dynamic interaction between real interest rates and real exchange rates that may also be of more general interest: under the null of the RERI, shocks to the real interest rate differential should only have a transitory impact on the real exchange rate, whereas shocks that do not affect the real interest rate differential should be associated with the permanent component. We find that these hypothesized relationships are in fact in the data. Furthermore, we also find that a positive interest rate shock leads to a temporary decline (appreciation) in the real exchange rate that is then gradually offset as relative prices and nominal interest rates adjust. This, again, is very much in line with theoretical predictions. We examine the robustness of this conclusion using an adaptation of the method suggested by King and Watson (1997), which involves examining the robustness of the response of the two variables to the choice of identification scheme. Interestingly, it turns out that our structural conclusions are independent of the particular approach to identification that we choose: the same pattern arises based on long-run identification schemes in the spirit of Blanchard and Quah (1989), more conventional short-run Choleski decompositions and, in fact, based on most other possible identifications.

The outline of the remainder of this paper is as follows. In the next section we consider the RERI relationship in some detail and discuss how the VAR-based method of Campbell and Shiller (1987) can be adapted to explore the RERI link. We then go on to outline how the relationship can be identified using the projections from a simple VAR model. In Section 3 we present our empirical results, while in Section 4 we examine the impact of structural shocks on the long-run relationship between real exchange rates and the real interest differential. Section 5 provides a further discussion of our results and concludes.

2. The RERI as a present value relationship

The standard derivation of the RERI (see, for example, Meese and Rogoff, 1988) has as its starting point the familiar risk adjusted uncovered interest parity condition:

$$\mathbf{E}_t(s_{t+1} - s_t) = (i_t - i_t^*) + \sigma_t, \tag{1}$$

where s_t is the log of the spot exchange rate (home currency price of a unit of foreign exchange), i_t is the one period domestic interest rate, $\mathbf{E}_t$ is the conditional expectations operator, an asterisk denotes a foreign magnitude and σ_t is a stationary (time-varying) risk premium. The latter term is often alternatively referred to as an excess return and we shall consider it in more detail below. Assuming rational expectations, Eq. (1) may be rewritten as

$$s_{t+1} - s_t = (i_t - i_t^*) + \sigma_t + \varepsilon_t, \tag{2}$$

where is ε_t is an *iid* random error.

The nominal exchange rate is usually thought of as an $I(1)$ process and it therefore follows that the left-hand side variable in (2), $s_{t+1} - s_t$, must be $I(0)$. Since $\sigma_t + \varepsilon_t$ is stationary, by assumption, it follows that the interest differential, $i_t - i_t^*$, must also be stationary—the domestic interest rate must be cointegrated with the foreign interest rate. The balanced nature of this expression, in terms of the orders of integration, is a standard feature of arbitrage conditions and is the starting point of the cointegration testing methods first proposed by Campbell and Shiller (1987) for present-value models. It turns out that translating (2) into the equivalent real interest parity condition produces a similar balance in terms of the integratedness of the right- and left-hand side variables. For example, by subtracting the expected inflation differential, $\mathbf{E}_t(p_{t+1} - p_t) - \mathbf{E}_t(p_{t+1}^* - p_t^*)$, from both sides of (2), where p_t denotes the log of the domestic price level, and assuming

[1] See Engel and West (2004) for a discussion of the implications of a unitary discount rate in a present value variant of the monetary exchange rate model.

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