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# Euro-dollar real exchange rate dynamics in an estimated two-country model: An assessment ☆

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ABSTRACT

Several theoretical contributions using two-country models have combined alternative forms of pricing under nominal rigidities with different asset market structures to explain real exchange rate dynamics. We estimate a two-country model using data for the United States and the Euro Area, and study the importance of such alternative assumptions in fitting the data. A model with local currency pricing and incomplete markets does a good job in explaining real exchange rate volatility, and fits the dynamics of domestic variables well. The complete markets assumption delivers a similar fit only when the structure of shocks is rich enough.



## 1. Introduction

Most puzzles in international macroeconomics are related to real exchange rate dynamics. Fluctuations in real exchange rates are very large and persistent when compared to other real variables, while most models cannot account for this fact.[1] In addition, most models assume that financial markets are complete at the international level, while there is clear empirical evidence of lack of consumption risk-sharing across countries. In order to explain main features of real exchange rates and consumption behavior across countries, a newer generation of models known as the New Open Economy Macroeconomics (NOEM) literature, has incorporated either nominal rigidities, alternative structures of assets markets, or both. Some examples include Benigno (2009), Lane (2001) and Obstfeld and Rogoff (2000).

Why are these two extensions necessary? The real exchange rate between two countries is defined as the ratio of price levels expressed in a common currency. When all the components of the price level—namely domestically produced and imported goods—are sticky, it can be possible to explain real exchange rate volatility, as shown by Benigno (2004). It is also well known that under complete markets, the real exchange rate is equal to the ratio of the marginal utility of consumption across countries. In fact, a separable log utility function on consumption implies that the real exchange rate and the ratio of consumption levels across countries have a correlation of one. This relationship does not hold for many bilateral relationships in general, a fact originally labeled the Backus and Smith (1993) paradox. For the bilateral euro-U.S. dollar

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[1] See, for instance, Heathcote and Perri (2002).

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exchange rate in particular, the correlation between the real exchange rate and the ratio of consumption levels in both countries (taking logs and first differences) is −0.18. Hence, models that incorporate complete markets are bound to fail in explaining key features of the international dimension of the data, as shown by Chari, Kehoe and McGrattan (2002, CKM) in a model with several nominal and real rigidities but with monetary policy shocks only.

Motivated by the difficulties of most international macromodels in matching real exchange rate fluctuations and by the results in CKM, in this paper we use a Bayesian approach to estimate a two-country NOEM model under different assumptions of imports goods pricing and asset markets structures. We use data for the euro area and the United States. Our baseline model is a two-country extension of Smets and Wouters (2003, 2007), and Christiano et al. (2005), to which we include two additional features. First, we assume local currency pricing (LCP), meaning that prices are sticky in the currency of the destination market, and second, we assume incomplete financial markets. Hence, the baseline framework includes several nominal and real rigidities that improve the model's fit to the data in a closed economy context, and additional features that have been suggested to explain main facts of international business cycles and real exchange rates. Then, we conduct a model comparison exercise and analyze the implications of introducing the simplifying assumptions of producer currency pricing (PCP), where the law of one price holds for imported and exported goods, and complete international financial markets. It is well established that the assumption of complete markets is convenient to obtain theoretical analytically tractable solutions for the real exchange rate. Thus, we want to test the implications and possible limitations of this asset market structure and analyze possible benefits of an alternative incomplete markets structure to match the data. We believe this comparison is valuable since it factors to what extent financial markets integration affects both: (i) parameter estimates of the model; and (ii) the transmission mechanism of shocks in international business cycles models.

The main contributions of the current paper are on model comparison and the models' implications for the euro-dollar real exchange rate. Using the Bayes factor to compare between competing alternatives, we find that both features, LCP and incomplete markets are important to explain real exchange rate dynamics. We obtain a good fit to the data, both for domestic variables and for the real exchange rate. We find that it is easier to distinguish between competing asset markets structures when shocks to the risk sharing condition across countries, such as uncovered interest rate parity (UIP) shocks are removed from the estimation. This result makes sense if we think that these UIP shocks make up for the possible misspecification of the asset market structure in the model. We find that in our preferred model about 50 percent of the real exchange rate volatility is explained by the UIP shocks. We find that supply, demand and preference shocks explain roughly an equal share of the real exchange rate variance, while monetary policy shocks have had a negligible contribution to real exchange rate fluctuations.

The literature on estimating NOEM models in the spirit of the models such as CKM and Galí and Monacelli (2005) has grown rapidly, with the adoption of the Bayesian methodology to an open economy setting already used in a closed economy environment. Lubik and Schorfheide (2007) estimate small open economy models with data for Australia, New Zealand, Canada and the U.K., focusing on whether the monetary policy rules of those countries have targeted the nominal exchange rate. Justiniano and Preston (2009) also estimate a small open economy model with an emphasis on the consequences of introducing imperfect pass-through on the international dimension of the data. Adolfson et al. (2007) estimate a medium-scale (15 variable) small open economy model for the euro area, and focus on the importance of several nominal and real frictions, as well as on which shocks are important to explain the data. Moving to a two-country model set up, Lubik and Schorfheide (2006), and De Walque et al. (2005) estimated models using U.S. and euro area data.

The rest of the paper is organized as follows. In the next section we outline the baseline model. In Section 3 we report the model's dynamics highlighting the role of LCP and incomplete markets. In Section 4 we document the data, priors and econometric strategy. The estimation results can be found in Section 5. In Section 6 we discuss several robustness exercises regarding the pricing of exports and asset market assumptions. In Section 7 we conclude.

## 2. The model

In this section we present the stochastic two country model that we will use to analyze real exchange rate dynamics. We estimate a two-country version of Christiano et al. (2005) and Smets and Wouters (2003, 2007). As in CKM, our benchmark model assumes that there is local currency pricing for goods that are shipped internationally. In addition, we assume that there is an incomplete asset market structure at the international level: agents only have access to one uncontingent bond that is denominated in foreign-country currency. The model incorporates 16 shocks because in the econometric section we are interested in explaining 15 variables.[2]

We assume that there are two countries, home and foreign, of equal size. Each country produces a continuum of intermediate goods, indexed by $h \in [0,1]$ in the home country and $f \in [0,1]$ in the foreign country, which are traded internationally. These intermediate goods are used in the production of the final good that is used for domestic final

[2] We include more shocks than observable variables since it helps to fit the data better and lowers misspecification problems as in Smets and Wouters (2003). In the robustness section below, we reestimate the model without the uncovered interest rate parity (UIP) shock, that affects the risk sharing condition across countries, and hence we will have the same number of shocks than variables.