Economic Modelling 46 (2015) 53–60

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Bayesian forecasting of real exchange rates with a Dornbusch prior ☆

Michele Ca' Zorzi [a,*], Andrzej Kocięcki [b], Michał Rubaszek [b,c]

[a] European Central Bank, Kaiserstrasse 29, 60311 Frankfurt, Germany
[b] National Bank of Poland, ul. Świetokrzyska 11/21, 00-919 Warsaw, Poland
[c] Warsaw School of Economics, Al. Niepodległ ości 162, 02-554 Warsaw, Poland

ARTICLE INFO

Article history:
Accepted 28 October 2014
Available online 12 January 2015

Keywords:
Exchange rate forecasting
Structural Bayesian VAR
Dornbusch model

ABSTRACT

This paper assesses if a Bayesian VAR with a Dornbusch prior outperforms the random walk model in predicting real exchange rates. Our main contributions are twofold. First, from a methodological point of view we apply an innovative framework to estimate structural Bayesian VAR models. Second, we provide evidence that a VAR with a Dornbusch prior can generate more accurate forecasts for real exchange rates than a standard VAR model based on the random walk prior and the naïve random walk model.

1. Introduction

Exchange rates have fascinated and occupied some of the best minds in the history of economic thinking. That they matter is undisputed: it is hard to see how one could possibly assess the global interactions among countries without understanding the driving forces of exchange rates. For this reason over the centuries several plausible exchange rate theories have been developed. Although some of these models survive in the back of our minds, as we attempt to interpret exchange rate movements, it is remarkable how little empirical evidence has been found to support any of them. Following the seminal papers by Meese and Rogoff (1983a,b), a consensus view has emerged that economic theory is of little help not only from a forecasting perspective but also to understand what drives exchange rates. This nihilistic conclusion has prevailed for almost 30 years and is often dubbed as "the exchange rate puzzle". Albeit the global financial crisis has spurred some challenging methodological debates in the field of macroeconomics, this broad consensus on exchange rates is not a disputed area: if anything the strong performance of the US dollar in the wake of the financial crisis originating from the heart of the financial center, i.e. the United States, has been taken by some as further anecdotal evidence that exchange rate movements cannot be rationalized in any way. The unsatisfactory state of affairs is that economists must continue seeking ad-hoc ex-post explanations when sizable exchange rate moves occur.

Albeit this failure of the economic profession is hard to accept, the exchange rate puzzle has found repeated confirmations in the literature. Even though Mark (1995) and Chinn and Meese (1995) brought forward the thesis that the random walk (RW) model could be beaten at least at longer horizons, more recent studies have instead reinstated the original intuition of Meese and Rogoff. For example, in a comprehensive study, Cheung et al. (2005) conclude that none of the standard theoretical models (monetary, interest rate parity, Balassa–Samuelson or the behavioral equilibrium exchange rate approach) is able to consistently outperform a RW in exchange rate forecasting. In light of these difficulties a second strand of the literature progressed and became increasingly popular. Instead of searching for economic fundamentals it investigated if a-theoretical approaches could outperform the RW benchmark. Different avenues were followed as researchers examined non-linear time series approaches, such as those based on Markov-switching techniques (e.g. (Engel and Hamilton, 1990; Engel, 1994; Clarida et al., 2003)), artificial neural networks (see the survey in Yu et al. (2007)) or the smooth transition autoregressive models (Kilian and Taylor, 2003). Our reading of the literature is that these a-theoretical models still encounter considerable difficulties in systematically outperforming the RW model. As a result, the "exchange rate puzzle" seems well positioned to remain the mainstream view despite the numerous attempts to challenge it (see Rogoff (2009), for more extended discussion on this subject).

A surprising feature of the open economy literature is that the large majority of economists concentrated on the predictability of nominal exchange rates, while only a few on real exchange rate (RER) forecasting. Understandable as this may be from a financial investor's point of view, the 'real' concept should matter at least as much from a macroeconomic perspective, as it gives an insight on the competitiveness of a country. While in terms of nominal exchange rates the emphasis is on their "disconnect" from economic fundamentals, the literature on RERs is less univocal and the debate wide open. Part of the literature starts from the "presumption" that RERs are driven by the Purchasing

☆ The views expressed herein are those of the authors and not of the institutions they represent.

* Corresponding author.
E-mail addresses: michele.cazorzi@ebc.int, michele.cazorzi@ecb.europa.eu (M. Ca' Zorzi), andrzej.kociecki@nbp.pl (A. Kocięcki), michal.rubaszek@nbp.pl (M. Rubaszek).

http://dx.doi.org/10.1016/j.econmod.2014.10.060
0264-9993/

Power Parity (PPP) model only to conclude that the model or the estimation method is imperfect ("the PPP puzzle" literature). Another strand of the literature tends to be more dismissive of the validity of the PPP hypothesis, pointing to the several determinants that may drive RERs. This route, followed also by the equilibrium exchange rate literature, encounters however considerable difficulties over the choice of the appropriate fundamentals and the conclusions vary a lot across different studies (for reviews see MacDonald (1995); Bussiere et al. (2010)).

Even if techniques and terminology have changed, the debate on the PPP and RER determinants is not a novelty in exchange rate economics. Already in the 1920s, even the strongest supporter of the PPP theory, Cassel, admitted that there were PPP disturbances, but saw them as of second order importance. In response to this apparent theoretical gap, in the 1970s and 1980s Dornbusch led the way in developing formal models that could help explain deviations from the PPP in terms of monetary policy shocks. The most well recognized explanation is the sticky price literature originated by the "overshooting" paper of Dornbusch (1976), in which PPP deviations are explained by current and expected real interest rate differentials (RID). Since then, the existence of a link between RER and RID has become an important empirical question in economics. While the results of the early paper by Meese and Rogoff (1988) rejected the notion of a stable RER–RID relationship (using both in-sample and out-of-sample tests), more favorable results are found in later studies. In particular, Mark and Choi (1997) found that real interest rate differentials help in forecasting real exchange rates over longer horizons, whereas a number of studies suggest that countries with relatively high real interest rates tend to have currencies stronger than average in real terms (see Engel (2011), for a review). In the recent years there has been a partial reappraisal of the Dornbusch model. While Rogoff (2002) stressed that the key to its long standing success and survival is its elegance, Bjornland (2009) or Keblowski and Welfe (2012) went further and argued, using a VAR based analysis, that some of its empirical features hold empirically.

In this paper the relevance of the Dornbusch model is assessed in terms of its forecast accuracy. For that purpose, we compile monthly real bilateral exchange rates of four major currencies vis-á-vis the US dollar for the period spanning between January 1975 and August 2011. Our aim is to compare the performance of a Structural Bayesian VAR (SBVAR) with a theoretical prior based on the Dornbusch model against two a-theoretical benchmarks: a standard RW model and a Bayesian VAR based on a RW prior. Setting the Dornbusch prior specification is however not possible with the standard treatment of SBVAR models. Therefore, we apply the novel methodological approach proposed by Kocięcki et al. (2012), which is particularly suited for eliciting prior information on the contemporaneous relationships suggested by economic theory. Finally, we evaluate the three alternative models in terms of their ability to forecast RERs.

Our contribution to the literature is therefore twofold. First, from a methodological point of view, we apply a new Bayesian method. Second, we add to the rather narrow literature on RER forecasting, by showing the relatively good performance of the SBVAR model with a prior based on the Dornbusch model.

The rest of the paper is structured as follows. Section 2 outlines the economic model standing behind the RER–RID relationship. Section 3 presents the SBVAR methodological framework. Section 4 describes the data. Section 5 discusses the empirical results of our forecasting contest. Section 6 concludes.

2. The economic model

In this section we derive the specification of the "Dornbusch" prior for a SBVAR model. To this aim we present the standard sticky-price model of Dornbusch (1976), following closely Meese and Rogoff (1988).

Let s_t be the log of the nominal exchange rate expressed as the foreign currency price of a unit of domestic currency, i_t and i_t^* be the one-period interest rate at home and abroad and E_t is the operator of expectations formulated in period t. The uncovered interest parity (UIP) condition is:

$$E_t(s_{t+1}) - s_t = i_t^* - i_t. \tag{1}$$

Let $q_t \equiv s_t + p_t - p_t^*$ be the log real exchange rate, where p_t and p_t^* are the log of home and foreign price levels, respectively, and $d_t \equiv (i_t - i_t^*) - E_t((p_t - p_{t+1}) - (p_t^* - p_{t+1}^*))$ be the real interest rate differential. The real UIP condition, which can be obtained by subtracting the expected inflation from both sides of Eq. (1), is:

$$q_t = E_t(q_{t+1}) + d_t. \tag{2}$$

Forward iteration of Eq. (2) yields:

$$q_t = \lim_{k\to\infty} E_t(q_{t+k}) + \sum_{k=0}^{\infty} E_t(d_{t+k}) \tag{3}$$

Let us also assume that q_t is expected to return to its equilibrium value $\overline{q}_t$ at a constant rate $\theta < 1$:

$$E_t(q_{t+k} - \overline{q}_{t+k}) = \theta^k (q_t - \overline{q}_t) \tag{4}$$

and that expectations of $\overline{q}_t$ satisfy:

$$E_t(\overline{q}_{t+k}) = \overline{q}_t. \tag{5}$$

The combination of Eqs. (4) and (5) implies $lim_{k\to\infty} E_t(q_{t+k}) = \overline{q}_t$, which substituted to Eq. (3) yields:

$$q_t = \overline{q}_t + \sum_{k=0}^{\infty} E_t(d_{t+k}). \tag{6}$$

It can be noted that if Eqs. (4), (5) and (6) hold then d_t is mean-reverting:

$$E_t(d_{t+k}) = \theta^k d_t, \tag{7}$$

which implies that:

$$\sum_{k=0}^{\infty} E_t(d_{t+k}) = \frac{1}{1-\theta} d_t. \tag{8}$$

Finally, the substitution of Eqs. (8) to (6) yields the RER–RID equation, i.e.:

$$q_t = \overline{q}_t + \frac{1}{1-\theta} d_t. \tag{9}$$

In the literature, the out-of-sample test of the RER–RID relationship is carried out by comparing the forecast accuracy of the RER–RID model to the RW (Mark and Choi, 1997; Meese and Rogoff, 1988). Forecasts from the RER–RID model are generated in two steps. First, one estimates the parameters of the RER–RID relationship and calculates the series of deviations from the estimated regression. Second, the series of deviations is used to predict future movements of the RER.

In this article we propose instead a one-step procedure. Our proposal consists of treating the Dornbusch model as a prior for a bivariate SBVAR model for q_t and d_t. The prior is given by the structure of the Dornbusch model (Eqs. (7) and (9)) and by the key parameter θ. The economic interpretation is in this context entirely straightforward: having a prior for θ means having, at the same time, a prior on the persistence of d_t (Eq. (7)) and on the strength of the contemporaneous relation between q_t and d_t (Eq. (9)). The implementation of this prior