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Behavioural asymmetries in the G7 foreign exchange market

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ABSTRACT

This paper examines the exchange rate disconnect puzzle of Obstfeld and Rogoff (2000) from a behavioural perspective. It provides evidence on the existence of substantial asymmetries in the underlying loss preferences for the difference between the spot and forward nominal exchange rates between the G7 countries for one-week and four-week forecast horizons. We further perform forecast breakdown tests in forward markets during the Greek and the Portuguese sovereign debt crisis, and then re-estimate the loss preferences showing a mean-reverting transition from optimism to pessimism and vice versa. Finally, we attribute the evolution of preferences to economic fundamentals and risk indexes and find that together with significant endogenous dynamics, variables such as growth and deficit differentials, interest rate and legal risk assert some significant impact on asymmetry. This new set of information suggests that the puzzle could have its roots on an underlying asymmetric loss function that reflects variability in preferences over exchange rate movements due to a variety of episodes in economic fundamentals.

1. Introduction

In their seminal paper Meese and Rogoff (1983) argue that 'exchange rate macroeconomic models, forecast exchange rates in the short- and medium-term no better than a random walk', whereas this puzzle was named as the *exchange rate disconnect puzzle* in (Obstfeld & Rogoff, 2000).

A simple model for testing the above puzzle is given as:

$$s_{t+1} - s_t = \alpha + \beta(f_t - s_t) + \varepsilon_{t+1} \quad (1)$$

where s_t, and f_t stands for the spot and one-period forward rate at time t respectively. The above equation is essentially an error-correction mechanism, which under the null hypothesis of forward rate forecast unbiasedness, should exhibit $\beta = 1$ and $\alpha = 0$. Empirical tests of the above equation failed to produce a silver bullet, see Clarida and Taylor (1997), and Clarida, Sarno, Taylor, and Valente (2001). Departing from this hypothesis would imply failure of rational expectations and market efficiency. Mark (1995) and Mark and Sul (2001) focus on the econometric issues and the underlying time series properties of the spot and forward exchange rate and show that the puzzle holds. However, Berkowitz and Giorgianni (2001) and Faust, Rogers, and Wright (2003) provide evidence that tends to accept market efficiency and thus reject the puzzle. In a recent study, Lothian and Wu (2011) construct ultra-long time series that span two centuries of exchange rates to test the uncovered interest parity and document the presence of substantial biases in the formation of expectations.

The present paper fills a gap in the literature by offering an alternative path of investigation, employing a recent testing and estimation procedures proposed by Elliott, Komunjer, and Timmermann (2005) and Giacomini and Rossi (2009). We view the forward exchange rate as a pure market forecast of the future spot rate and ask the following question: are asymmetries over the underlying loss function of the spot −forward forecast error responsible for the observed biases in Eq. (1)? The presence of such asymmetries could provide an alternative explanation of the disconnect puzzle, implying the presence of preference-based rational bias in the formation of expectations. Furthermore, we depart from the literature that attempts to identify the main determinants of the exchange rate and provide an analysis of the correlation between the preference asymmetry parameter estimate and a number of fundamental economic variables, thus identifying the main variables that affect the formation of preferences and thus expectations in the market as mirrored in the loss function.

Our findings suggest the presence of significant loss preference asymmetries in forward foreign exchange markets especially for longer horizons, which are shown to evolve over time in conjunction with detected forecast breakdowns, often in response to changes in economic fundamentals and risk indices. These results provide a new perspective to explain the exchange rate disconnect puzzle whilst offer a new information set for market participants in forward markets and policy makers alike. In some detail, to the extent that underlying preferences

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of forward markets are revealed and become common knowledge all participants could take advantage of this information and readjust their preferences if needed. The main reason of readjusting their preferences is that if all share the same symmetric or, indeed, asymmetric loss function this would contribute towards rationality in their behaviour. On the other hand, the absence of a common loss function could help explain why '*exchange rate disconnect puzzle*' prevails. It might be simply the case that not all participants in forward markets share the same loss function.

In Section 2 we present a brief literature review, in Section 3 we outline our methodological estimation and testing framework and in Section 4 we present our data set and empirical results on forecast breakdown and preference parameter estimation. In Section 5 we outline our analysis and results for the attribution of estimated preference parameters to economic fundamentals, and in Section 6 we conclude.

2. Literature review

There is no consensus in the literature on the factors affecting exchange rates. The debate focussed at the beginning on the role of macroeconomic fundamentals in short- and long-run forecasting versus random walk and later on the presence of non-linearities. In the first debate, three principal views have emerged in the literature: First, for macroeconomic versus random walk forecasts for short-time horizons and for countries without high inflation, macroeconomic fundamentals do not seem to perform better than a random walk in out-of-sample forecasting, see Meese and Rogoff (1983). Second, macroeconomic fundamentals do play an important role in explaining the behaviour of exchange rates, see McDonald (1999). For some authors such fundamentals are important in the long run but have little to offer in explaining short-run movements, whilst for others macroeconomic fundamentals contribute to both long run and short run dynamics. Last, neither macroeconomic fundamentals nor the random walk model adequately account for exchange rate behaviour at short horizons. This view attributes short-run exchange rate movements to market microstructure factors, such as inventory management and information aggregation, often reflecting adaptive learning processes about the economic fundamentals, see Lyons (2001).

Kilian and Taylor (2003) provide empirical evidence showing that the evolution of the real exchange rate is well approximated by a non-linear, exponential smooth transition autoregressive (ESTAR) model, accounting for the presence of persistence and volatility of real exchange rates. Kilian and Taylor found strong evidence of predictability for horizons of 2 to 3 years, but not for shorter horizons. Furthermore, other research work documenting various nonlinearities in deviations of the spot exchange rate from economic fundamentals has been contributed by Balke and Fomby (1997), Taylor and Peel (2000), Taylor, Peel, and Sarno (2001). These studies offer empirical support to exchange rate predictability and reconcile the presence of economic fundamentals, see also Allen and Taylor (1990, 1992), Taylor and Allen (1992), Cheung and Chinn (1999).

3. Methodology

The empirical testing of Eq. (1) has been based on statistical criteria penalising symmetrically over- and under-forecasting. We deviate fundamentally from this practice and focus on the structure of the market forecast decision-making process. We view the distance between a market-based forward rate and the corresponding future spot rate as a forecast error generated through a forecast decision making process: the market chooses at time t the forward rate referring to period $t+s$ which minimises the expected loss resulting in from mis-forecasting. It is known, see Granger (1969) and Christoffersen and Diebold (1997), that in the presence of asymmetric loss preferences, optimal forecasts are composed of the conditional expectation plus a rational bias component involving a non-linear interaction between the shape of the loss function and higher moments of the variable to be forecasted. It is exactly the presence of this rational bias that may explain the failure of testing procedures under Eq. (1). In the following we shall outline an estimation procedure for the underlying loss function, a statistical test for forecast rationality, as well as a statistical test for forecast breakdown in the presence of generalised loss preferences.

3.1. Estimation of preferences

Observing time series of past exchange rate forecast errors we shall follow Elliott et al. (2005) to devise a Method-of-Moments estimator for the parameter controlling the shape of the underlying loss function.

Consider a flexible loss function of the form:

$$L(p,\alpha)\equiv\left[\alpha+(1-2\alpha)\cdot 1_{(s_{t+s}f_{t+s}<0)}\right]\left|s_{t+s}-f_{t+s}\right|^{p} \tag{2}$$

where, $s_{t+s}-f_{t+s}$ is the s-period-ahead exchange rate forecast error, $p=1, 2$, $\alpha\in(0,1)$, **1** is an indicator that takes value of 1 if $s_{t+s}-f_{t+s}$ negative and zero otherwise. For $p=1$ the above equation nests the double linear function (Lin–Lin) and for $p=2$ it nests the double quadratic function (Quad–Quad). For $\alpha=1/2$ the loss function is symmetric and for $\alpha<1/2$ ($\alpha>1/2$) the loss exhibits asymmetry towards a higher penalty for over-predictions (under-predictions).

By observing the sequence of spot − forward forecast errors $\{s_{t+s}-f_{t+s}\}$, $\tau\le t<T+\tau$ an estimate for α is constructed using a linear Instrumental Variable estimator $\hat{\alpha}_T$, as follows:

$$\hat{\alpha}_T=\frac{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1}vt\left|s_{t+s}-\hat{f}_{t+s}\right|^{p-1}\right]'\hat{S}^{-1}\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1}vt1_{(s_{t+s}-\hat{f}_{t+s}<0)}\left|s_{t+s}-\hat{f}_{t+s}\right|^{p-1}\right]}{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1}vt\left|s_{t+s}-\hat{f}_{t+s}\right|^{p-1}\right]'\hat{S}^{-1}\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1}vt\left|s_{t+s}-\hat{f}_{t+s}\right|^{p-1}\right]} \tag{3}$$

where v_t is a D × 1 vector of instruments, which is a subset of the full information set W_t used to generate $\hat{f}$, and $\hat{S}$ is given by:

$$\hat{S}(\overline{\alpha}_T)=\frac{1}{T}\sum_{t=\tau}^{T+\tau-1}vtvt'\left(1_{(s_{t+s}-\hat{f}_{t+s}<0)}-\overline{\alpha}_T\right)^2\left|s_{t+s}-\hat{f}_{t+s}\right|^{2p-2} \tag{4}$$

where $\overline{\alpha}_T$ is a consistent initial estimate of α_0. Since S depends on $\hat{\alpha}_T$, estimation is performed iteratively. In the first iteration we assume $\hat{S}=I$, the identity matrix, to estimate $\hat{\alpha}_1$, which is then used to re-estimate $\hat{S}$ and $\hat{\alpha}_2$ for the second iteration. The process is then repeated until convergence for S. Elliott et al. (2005) show that the estimator of $\hat{\alpha}_T$ is asymptotically normal and construct a J-statistic which under the joint null hypothesis of forecast rationality and flexible loss function is distributed as a $X^2(D-1)$ variable for D > 1, which takes the form:

$$J=\frac{1}{T}\left[\begin{array}{l}\left(\sum_{t=\tau}^{T+\tau-1}vt\left[1_{(s_{t+s}-\hat{f}_{t+s}<0)}-\hat{\alpha}_T\right]\left|s_{t+s}-\hat{f}_{t+s}\right|^{p-1}\right)'\hat{S}^{-1}\\ \times\left(\sum_{t=\tau}^{T+\tau-1}vt\left[1_{(s_{t+s}-\hat{f}_{t+s}<0)}-\hat{\alpha}_T\right]\left|s_{t+s}-\hat{f}_{t+s}\right|^{p-1}\right)\end{array}\right]\sim X^2(D-1). \tag{5}$$

For robustness in the empirical application, we apply Eqs. (3) and (4) for both $p=1, 2$ using two and three instruments (D = 2, 3), in particular a constant and lagged difference between spot and forward exchange rates as well as the latter two and the lagged spot.

In the context of asymmetric preferences given in Eq. (2) of our paper, f_{t+s} is an optimal forecast if and only if the first order forecast optimality conditions will be

$$E\left[W_t\left(1_{(s_{t+s}-\hat{f}_{t+s}<0)}-\alpha\right)\left|s_{t+s}-\hat{f}_{t+s}\right|^{p-1}\right]=0 \tag{6}$$