Market- implied loss preferences for the G10 forward exchange rates

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Abstract

This paper provides evidence on the existence of asymmetries in the underlying loss preferences for the difference between the spot and forward nominal exchange rate. We find that, in the context of both linear and non-linear loss functions, the underlying loss preferences for monthly data are predominantly asymmetric, whilst for weekly exchange rates asymmetry tends to weaken.

Keywords: Asymmetric preferences, Spot-forward exchange rates, GMM estimation, Lin-Lin.

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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 and Rogoff, 2000).

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

$$s_{t+1} - s_t = a + \beta\left(f_t - s_t\right) + \varepsilon_{t+1} \qquad (1)$$

where s_t, and f_t stands for the spot and forward rate at period t respectively. The above is basically an error correction model, 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, as a plethora of papers have not confirmed what refereed in the literature the risk neutral efficient market hypothesis (RNEMH) (see Clarida and Taylor 1997, and Clarida et al. 2001). Departing from this hypothesis would imply failure of rational expectations. Certainly, in spite of employing a plurality of statistical tests, the puzzle has caused heated debates and to this date one can not claim that those debates have been resolved. Mark, 1995 and Mark and Sul, 2001, focusing on the econometric issues, mainly on the underlying time series properties of the spot and forward exchange rate, show that the puzzle holds. However, Berkowitz and Giorgianni, 2001 and Faust et al., 2003 tend to provide evidence that accepts the RNEMH and thus rejects the puzzle.

The present paper fills a gap in the literature by offering an alternative path of investigation, employing a recent estimation procedure as proposed by Elliott et al (2005). We focus on a key question: are asymmetries over the underlying loss function between spot and forward exchange rates for the G10 countries responsible for the observed in some research (Mark and Sul, 2001 and Clarida et al. 2001) biases in equation 1? If indeed asymmetries were to be observed, then this would represent an alternative explanation of the disconnect puzzle, implying the presence of rational bias in the formation of expectations. In section 2 we outline our methodological framework, in section 3 we present out empirical analysis and in section 4 we conclude.

2. Methodology

The empirical testing of equation (1) has been based on the underlying hypothesis of a quadratic spot-forward exchange rate loss preference. We relax this hypothesis and present a framework that allows us to estimate possible asymmetries in the underlying loss function of the market-based difference between spot and forward exchange rate, thus permitting the measurement of the loss function shape formation. To this end, we follow Elliott *et al* (2005) consider a flexible loss function of the form:

$$L(p,\alpha) \equiv [\alpha + (1-2\alpha)\mathbf{1}(s_t - f_t < 0)]\left|s_t - f_t\right|^p \qquad (2)$$

where p=1,2, $\alpha \in (0,1)$, **1** is an indicator that takes value of 1 if s_t-f_t negative and zero otherwise, while s_t-f_t denotes the difference between the spot and the forward rate. For p=1 the above function nests the double linear (Lin-Lin) and the double quadratic (Quad-Quad) for p=2. For α<1/2 (α>1/2) the loss exhibits asymmetry towards a

higher penalty for over-predictions (under-predictions) and for α=(1/2) the loss is symmetric.

By observing the sequence of forwards $\{f_t\}$, $\tau \le t < T+\tau$ an estimate for α is constructed using a linear Instrumental Variable estimator $\hat{\alpha}_T$, as follows:

$$\hat{\alpha} = \frac{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t \left| s_t - \hat{f}_t \right|^{p_0-1}\right]' \hat{S}^{-1} \left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t \mathbf{1}(\mathbf{s}_t - f_t < 0) \left| s_t - \hat{f}_t \right|^{p_0-1}\right]}{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t \left| s_t - \hat{f}_t \right|^{p_0-1}\right]' \hat{S}^{-1} \left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t \left| s_t - \hat{f}_t \right|^{p_0-1}\right]} \qquad (3)$$

where v_t is a dx1 vector of instruments which is a subset of the information set used to generate $\hat{f}$, while $\hat{S}$ is given by:

$$\hat{S} = \frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t v_t' (\mathbf{1}(\mathbf{s}_t - f_t < 0) - \hat{\alpha}_\tau)^2 \left| s_t - \hat{f}_t \right|^{2p_0-2} \qquad (4)$$

Since S depends on α_T, estimation is performed iteratively. Assuming S=I in the first iteration we estimate α_T, which is then used to re-estimate for the second iteration. The process is then repeated until convergence for S. Elliott *et al* (2005) show that the estimator of α_T is asymptotically normal and construct a J-statistic which under the joint null hypothesis of rationality and flexible loss function is distributed as a X^2(d-1) variable for d>1 and takes the form:

$$J = \frac{1}{\mathrm{T}} \left[\begin{array}{l} \left(\sum_{t=\tau}^{\mathrm{T}+\tau-1} v_t \left[\mathbf{1}(\mathbf{s}_t - f_{\ t} < 0) \right] \left| s_t - \hat{f}_{\ t} \right|^{p0-1'} \right) \hat{S}^{-1} \\ \times \left(\sum_{t=\tau}^{\mathrm{T}+\tau-1} v_t \left[\mathbf{1}(\mathbf{s}_t - f_{\ t} < 0) - \hat{\alpha}_T \right] \left| s_t - \hat{f}_{\ t} \right|^{p0-1} \right) \end{array} \right] \sim X^2_{d-1} \qquad (5)$$

For robustness in the empirical application, we estimate equations (3) and (4) for both p=1and p=2 using two and three instruments (D=2 or 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 equation (2) of our paper, f_{t+1} is an optimal forecast if and only if the first order forecast optimality conditions will be

$$E\left[W_t \left(\mathbf{1}_{sY_t - f_{t+1} < 0)} - a \right) \left| s_t - f \right|^{p-1} \right] = 0 \qquad (6)$$

, where W_t is the full set of factors and are known to the forecaster at time t and a is the loss asymmetry parameter.

If for given a and p the forecaster uses the above condition to determine f_{t+1} (Elliott et al show that this solution is unique), then for given f_{t+1} it is possible to use the same condition to uniquely back out a.

Then, Lemma 2 of Elliott et al. proves that the above condition is sufficient to identify a using a sub vector V_t of W_t. In this respect, we have performed robustness checks by using subsets of our three instruments which yielded close estimates for the

parameters but with inferior standard errors, whilst impairing the speed of algorithm convergence.

3. Data and Results

Our data set is consists of monthly and weekly series of the spot and forward exchange rate of G10, that is G7 countries plus Russia (RBLE), China (YUAN) and India (RUPEE) for the period 2002 till 2006.[1] The data source were retrieved from Data-stream, and they are collected WM/Reuters. For Russia the time period is shorter due to data availability, the starting point is April 2004.

This data set is used in the context of both linear and non-linear loss functions as depicted by equation 2. To this effect, we do not impose any specific preference structure since both symmetric and asymmetric loss functions are included in the model as special cases. The parameter estimate of our interest is α, which determines the preference asymmetry of the loss function. For $\alpha = 0.5$ the loss function is symmetric with respect to positive or negative exchange rate premium, that would imply the rational expectations hypothesis under equation 1. For $\alpha < 0.5$ the loss function exhibits asymmetry towards a higher penalty for over-prediction, that means negative exchange rate premium, which in turn would imply bias to the direction of appreciation of the denominating currency. Likewise, for $\alpha > 0.5$ the loss function exhibits asymmetry towards a higher penalty for under-prediction, that means positive exchange rate premium, that in turn would imply bias to the direction of depreciation of the denominating currency.

[1] The rest of the exchange rates employed here are: EUR=euro, USD=US dollar, JPY=Yen, GBP= British pound, CAN=Canadian dollar.

We report results for the difference between the spot and forward exchange rate for the G10 in Tables 1 and 2 for both quadratic (p=2) and linear (p=1) loss functions using three (D=3) instruments.[2] Our estimated loss function parameters are all statistically different from zero as our estimated standard errors suggest. Table 1 reports parameter estimates for exchange rates of monthly frequency, while Table 2 presents results for weekly frequency. We also report the J-statistic for four null hypotheses, $H_0 : a = \hat{a}$ (from the estimation), α=0.2, α=0.5, and α=0.8.

<<Table 1 about here>>

Table 1 reports for the cases of both linear and quadratic loss that only in five out of twenty eight cases the estimated parameter, α, is centred around 0.5, suggesting symmetric preferences as proposed by the standard rational expectations hypothesis and in contrast with the puzzle. For the cases of YUAN/EUR, RUPEE/USD, JPY/GBP, and YUAN/RUPEE the parameter estimate of α for the linear case of loss function does not provide statistical meaningful evidence neither for symmetry nor for asymmetry, whilst in the case of quadratic loss the JPY/GBP and YUAN/RBLE exhibits estimates of α statistically less than 0.5. Interestingly, estimates of the asymmetry parameter α are predominantly taking values of less than 0.5, while for only three cases (RBLE/EUR, CAN/USD, and RBLE/USD) α takes values higher than 0.5, implying that the market loss preference assigned higher cost for positive exchange rate premiums, which in turn corresponds to depreciation of the denominating currency. These results clearly suggest that the predictability in the exchange rate is heavily asymmetric in terms of the underlying loss function, incorporating a rational bias.

[2] The main results hold also in the case of one or two instruments. Results are available upon request

<<Table 2 about here>>

Table 2 reports for weekly exchange rates that only in seven (CAN/EUR, RBLE/EUR, JPY/USD, CAN/USD, EUR/GBP, RBLE/CAN, JPY/YUAN) out of twenty eight cases the estimated parameter, α, is clearly centred around 0.5, suggesting symmetric preferences. Further, for six additional exchange rates (CAN/GBP, RBLE/GBP, RUPEE/GBP, RUPEE/RBLE, JPY/RUPEE, RUPEE/YUAN) the J-statistics would lean towards symmetry in the margin, though the hypothesis of slight downward asymmetry could not be rejected. For the cases of YUAN/EUR, RUPEE/USD, YUAN/RBLE, and YUAN/RUPEE the parameter estimate of α for the linear case of loss function does not provide statistical meaningful evidence neither for symmetry nor for asymmetry, whilst in the case of quadratic loss the YUAN/RBLE, and YUAN/RUPEE exhibits estimates of α statistically less than 0.5. Note that those exchanges rates refer to countries that are developing and their exchange rates are subject to heavily regulation in the formation of their exchange rates, insinuating non-linearities in the underlying loss preferences. Overall, estimates of the asymmetry parameter α takes values of less than 0.5 for many exchange-rates, whilst for just only one case (RBLE/USD), α takes values higher than 0.5. These results confirm the findings of Table 1, though it is worth emphasising that there is a higher tendency towards weaker asymmetry. This would suggest that in higher frequency data the market participants appear to undertake actions closer to symmetry and standard rational expectations hypothesis.

4. Conclusion

In this paper we examine the structure of the rationality of between spot and forward exchange rates in the context of the underlying asymmetric flexible loss functions. The estimate of the asymmetry parameter rejects for most of the monthly exchange rates the risk neutral efficient market hypothesis (RNEMH) and provides evidence of the existence of the disconnect puzzle. This picture is somehow weaker in the case of weekly exchange rates. This would imply that higher or lower premiums than realised hinder biasness and allow agents to exploit certain profits over arbitrage activities, conditional on the underlying transaction costs, more importantly so for monthly exchange rates rather than weekly.

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Table 1. Linear and Quadratic Loss Preferences, Monthly G10 spot forward e-rate

	D=3 P=1						D=3 P=2					
	$\hat{\alpha}$	SE	Ja	$J_{0.2}$	$J_{0.5}$	$J_{0.8}$	$\hat{\alpha}$	SE	Ja	$J_{0.2}$	$J_{0.5}$	$J_{0.8}$
USD/EUR	0.386	0.0634	5.3826	10.4239	7.468	23.688	0.2846	0.069	7.0485	7.5991	8.4101	17.6263
JPY/EUR	0.3078	0.0601	2.1866	4.7662	9.4829	30.3218	0.2613	0.068	2.6509	3.1005	8.6542	22.4775
RUPEE/EUR	0.4341	0.0645	2.958	11.8396	3.8971	20.7389	0.3588	0.0767	6.9747	8.1134	7.6298	14.8622
YUAN/EUR	0.3283	0.0611	7.659	9.7534	10.8802	26.526	0.2256	0.0633	7.99	8.0345	9.8971	18.7208
CAN/EUR	0.4505	0.0648	4.2366	13.328	4.7074	19.5885	0.4549	0.0839	3.8854	9.0811	4.0024	10.142
RBLE/EUR	0.5902	0.0883	1.6405	11.7265	2.3356	5.604	0.5676	0.1064	1.8343	7.5427	2.0227	4.5049
JPY/USD	0.5088	0.0651	1.2131	16.4622	1.2298	15.1826	0.4772	0.0811	6.565	10.0205	6.5888	11.719
YUAN/USD	0.2492	0.0563	0.5945	1.2908	14.9216	36.0995	0.2224	0.0918	1.2922	1.5146	7.3563	21.9965
CAN/USD	0.6749	0.061	5.1969	27.6671	9.4976	7.8471	0.7058	0.0715	4.8071	18.3194	7.3695	6.2194
RUPEE/USD	0.859	0.0453	13.4842	32.4401	20.5789	14.9756	0.9114	0.04	7.7198	24.7861	22.3045	13.3662
RBLE/USD	0.6319	0.0866	2.2357	13.1296	3.5105	4.8106	0.781	0.0924	3.5233	10.5532	4.8317	3.593
EUR/GBP	0.5298	0.065	4.3539	18.1874	4.4494	14.6354	0.4828	0.0789	4.7929	10.7918	4.8842	11.3893
USD/GBP	0.4337	0.0645	3.0963	11.9203	3.9493	20.7048	0.2743	0.0655	5.1456	5.8307	8.5445	17.4506
JPY/GBP	0.2987	0.0596	8.3908	10.0152	10.9271	27.7241	0.2221	0.0625	4.7944	4.8163	10.1612	20.5411
YUAN/GBP	0.4062	0.0639	5.5067	11.5228	6.7836	22.3028	0.2379	0.0606	5.0975	5.2453	10.1585	18.8744
CAN/GBP	0.5741	0.0644	5.8836	21.0417	6.6463	12.6917	0.4596	0.0835	3.7351	9.4173	3.8207	9.68
RBLE/GBP	0.5585	0.0892	2.6782	10.6531	3.0582	6.8624	0.4358	0.1109	2.6981	4.8018	2.9224	6.4898
RUPEE/GBP	0.3949	0.0636	3.3363	9.7537	5.5122	23.4755	0.3719	0.0785	4.719	6.8492	6.0574	14.3532
RBLE/CAN	0.4003	0.088	7.9774	9.1013	7.5106	11.0783	0.4726	0.1139	5.5374	8.0193	5.218	6.376
JPY/CAN	0.3353	0.0615	0.6606	4.9954	6.6168	28.7546	0.3502	0.0734	0.7557	4.4873	4.1474	19.0792
YUAN/CAN	0.327	0.0611	4.9299	7.7389	9.1842	27.6331	0.2527	0.0657	3.6458	4.244	9.3877	19.8886
JPY/RBLE	0.2366	0.0763	3.1611	3.2748	7.8529	17.4381	0.198	0.0821	2.373	2.3653	5.1146	12.3595
YUAN/RBLE	0.2492	0.0777	4.5354	4.5328	8.6449	16.24	0.129	0.0634	3.7211	4.465	8.006	11.7159
RUPEE/RBLE	0.3138	0.0833	3.4144	4.4733	5.5215	14.6219	0.3536	0.101	3.7738	4.2606	4.9499	8.3487
JPY/RUPEE	0.3956	0.0637	3.1561	9.7317	5.2347	23.4117	0.2899	0.071	6.3563	6.5329	9.3491	17.2135
YUAN/RUPEE	0.1217	0.0426	10.3341	12.8116	23.294	36.6045	0.0776	0.0399	6.5906	12.0162	18.7149	24.4405
JPY/YUAN	0.5452	0.0648	1.8637	19.1738	2.2701	12.85	0.5133	0.0807	5.0456	10.781	5.0392	10.5429
RUPEE/YUAN	0.4093	0.064	4.7046	11.219	6.1408	22.266	0.4051	0.0828	4.5201	7.1054	5.6546	14.5416

Table 2. Linear and Quadratic Loss Preferences, Weekly G10 spot forward e-rate

	D=3 P=1						D=3 P=2					
	$\hat{\alpha}$	*SE*	*Ja*	$J_{0.2}$	$J_{0.5}$	$J_{0.8}$	$\hat{\alpha}$	*SE*	*Ja*	$J_{0.2}$	$J_{0.5}$	$J_{0.8}$
USD/EUR	0.4207	0.0306	3.819	45.0316	9.8067	96.0477	0.4089	0.0369	7.5814	29.7733	12.4636	67.8935
JPY/EUR	0.4146	0.0306	1.2187	42.0205	8.6344	98.5572	0.4078	0.0396	1.8995	22.6751	6.8693	67.6011
RUPEE/EUR	0.4128	0.0305	3.8801	42.7351	11.179	98.8213	0.4504	0.0377	6.6333	35.0536	8.2508	61.4242
YUAN/EUR	0.3871	0.0302	10.4034	39.6465	20.246	106.1894	0.3785	0.0364	10.1195	26.1744	18.1195	72.7561
CAN/EUR	0.492	0.031	5.5582	67.155	5.6282	72.36	0.4799	0.039	4.1094	40.9239	4.368	47.9389
RBLE/EUR	0.5	0.0423	0.1157	37.0791	0.1157	37.0766	0.5038	0.0541	2.7367	23.1741	2.7307	22.1279
JPY/USD	0.4961	0.031	2.1515	67.903	2.1654	70.4575	0.4877	0.0392	4.4968	39.955	4.6208	46.7729
YUAN/USD	0.3031	0.0285	3.0394	14.8528	41.3538	138.5958	0.3441	0.0641	1.3468	5.3361	6.5822	30.8766
CAN/USD	0.5661	0.0307	1.3532	91.6871	5.7741	47.899	0.577	0.0378	2.7316	64.7205	6.6414	29.63
RUPEE/USD	0.6879	0.0287	20.8749	126.8591	44.7504	30.6682	0.7261	0.0395	15.9469	69.0767	35.002	17.1043
RBLE/USD	0.5783	0.0417	6.1403	51.1304	8.8011	26.2066	0.5888	0.051	1.65	33.8898	4.3623	16.1396
EUR/GBP	0.5156	0.031	2.176	74.4045	2.4296	64.0402	0.5065	0.0377	7.4383	46.7285	7.4348	46.8268
USD/GBP	0.4153	0.0306	6.0186	44.3875	12.7005	97.7091	0.4047	0.0376	5.3103	27.954	10.8487	67.1375
JPY/GBP	0.4346	0.0307	0.1226	47.6154	4.5617	91.5436	0.4116	0.0386	0.422	24.8715	5.4276	65.3028
YUAN/GBP	0.3914	0.0303	5.6356	37.6562	16.6566	105.9508	0.3834	0.0371	6.3842	24.9546	14.1856	70.9755
CAN/GBP	0.449	0.0308	2.6659	52.9896	5.2433	86.4201	0.4788	0.0386	5.4507	40.5889	5.7921	48.5976
RBLE/GBP	0.4561	0.0421	1.6366	29.7866	2.6619	45.2223	0.4901	0.0518	4.665	23.5366	4.7122	26.2509
RUPEE/GBP	0.4721	0.031	4.4606	60.7215	5.2005	78.6603	0.4472	0.0382	4.6209	35.0302	6.3106	57.7585
RBLE/CAN	0.5291	0.0422	1.3848	42.5127	1.8344	32.217	0.4845	0.0526	4.2046	23.2031	4.2573	24.9964
JPY/CAN	0.4414	0.0308	1.972	50.4129	5.4293	89.0491	0.4272	0.0388	0.2623	27.9941	3.7013	60.2605
YUAN/CAN	0.4256	0.0307	2.3489	45.7767	7.8572	94.542	0.3978	0.037	4.262	27.1641	10.6892	67.5764
JPY/RBLE	0.3761	0.0409	1.4023	17.1876	9.5132	60.3326	0.365	0.0501	0.7717	9.9447	7.3787	43.1369
YUAN/RBLE	0.4108	0.0416	8.3637	25.6003	11.7481	52.8181	0.3702	0.0514	3.3738	12.3165	8.5314	37.3911
RUPEE/RBLE	0.4478	0.042	2.9444	28.8676	4.3181	46.7312	0.4437	0.0523	4.9378	19.1479	5.8281	29.7585
JPY/RUPEE	0.4649	0.0309	1.7917	57.7584	2.9981	80.9125	0.4442	0.0397	5.2289	31.1609	6.9168	53.8067
YUAN/RUPEE	0.3048	0.0285	9.6016	20.6422	41.888	134.5514	0.3051	0.0433	5.354	9.7757	17.818	56.2776
JPY/YUAN	0.5039	0.031	2.6469	70.5507	2.6619	67.9792	0.5095	0.0389	4.1809	44.761	4.2082	43.2424
RUPEE/YUAN	0.4451	0.0308	2.3906	51.6914	5.4254	87.7628	0.4642	0.0386	2.1161	35.541	2.9888	56.6771