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Forecasting the Dollar/British Pound Exchange Rate: Asymmetric Loss and Forecast Rationality

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Abstract

We apply an approach recently developed by Elliott et al. (Rev. Ec. Studies. 72, 1197-1125, 2005) to study whether forecasts of the dollar/British pound exchange rate extracted from a panel of survey data are consistent with an asymmetric loss function. We find that only few forecasters seem to form forecasts under an asymmetric loss function. Accounting for the asymmetry of their loss function, however, often makes their forecasts look rational.

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1. Introduction

Exchange-rate expectations play a key role in modern theories of exchange-rate determination. Survey data of exchange-rate forecasts of professional exchange-rate forecasters are a particularly rich datasource for measuring exchange-rate expectations. In the literature on exchange-rate forecasts, a classic research question has been whether survey data of exchange-rate forecasts satisfy traditional rationality criteria like unbiasedness and orthogonality.

We apply an approach recently developed by Elliott *et al.* (2005) to re-examine the rationality of exchange-rate forecasts. To this end, we study whether professional forecasters' forecasts of the dollar/British pound exchange rate are consistent with an asymmetric loss function. Our sample of data comprises more than 5,000 exchange-rate forecasts and covers the time period 1995−2011. We find that the majority of exchange-rate forecasters seems to form exchange-rate forecasts under a symmetric loss function. Symmetry of the loss function implies that forecasters seek to minimize (in the case of a quadratic loss function) the mean-squared forecast error, an assumption on which traditional rationality criteria rest (Ito 1990, Elliott and Ito 1999). Such traditional rationality criteria, however, cannot be applied if exchange-rate forecasters' loss function is asymmetric (Batchelor and Peel 1999, Elliott *et al.* 2008). In our empirical study, we find that only few exchange-rate forecasters deliver forecasts that provide signs of an asymmetric loss function. As emphasized in the literature on asymmetric loss functions, however, we find that accounting for the asymmetry of the loss function often (but not always) makes forecasts of those forecasters whose forecasts can be described in terms of an asymmetric loss function look rational.

The approach developed by Elliott *et al.* (2005) has previously been used to study exchange rates by Christodoulakis and Mamatzakis (2008a). They, however, do not focus on the loss function of individual exchange-rate forecasters. Rather, they use the forward rate to study the link between market-wide exchange-rate forecasts and the forward premium bias puzzle. Thus, while Christodoulakis and Mamatzakis (2008a) focus on the market-wide average exchange-rate forecast (that is, the forward rate), we focus on the forecasts of individual exchange-rate forecasters. Another application of the approach developed by Elliott *et al.* (2005) to study exchange-rate forecasts can be found in a recent paper by Pierdzioch *et al.* (2012). In contrast to our research, they study forecasts of the Japanese yen. In addition, they study forecasts from a different data source (the Wall Street Journal poll). Finally, they study longer-term seminannual forecasts, while we analyze short-term and medium-term forecasts.

We describe the approach developed by Elliott *et al.* (2005) in Section 2. In Section 3, we describe our data and our empirical results. In Section 4, we offer some concluding remarks.

2. Theoretical Background

The loss function, $\mathcal{L}$, of exchange-rate forecasters is given by

$$\mathcal{L} = [\alpha + (1-2\alpha)I(s_{t+1} - f_{t+1} < 0)]|s_{t+1} - f_{t+1}|^p, \tag{1}$$

where s_{t+1} denotes the realization of the exchange rate, f_{t+1}, denotes the forecast formed in period t of the realization of the exchange rate in period $t+1$, I denotes the indicator function, $p = 1$ for a lin-lin loss function and $p = 2$ for a quad-quad loss function, and $\alpha \in (0, 1)$ governs the degree of asymmetry of the loss function. For $\alpha = 0.5$, the loss function is symmetric. For $\alpha = 0.5$ and $p = 2$, the loss increases in the squared forecast error. For $\alpha = 0.5$ and $p = 1$, the loss increases in the absolute forecast error.

Given this loss function, Elliott *et al.* (2005) show that, for a given parameter p, which defines the general functional form of the loss function, the asymmetry parameter, α, can be consistently estimated as

$$\hat{\alpha} = \frac{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t|s_{t+1} - f_{t+1}|^{p-1}\right]' \hat{S}^{-1} \left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t I(s_{t+1} - f_{t+1} < 0)|s_{t+1} - f_{t+1}|^{p-1}\right]}{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t|s_{t+1} - f_{t+1}|^{p-1}\right]' \hat{S}^{-1} \left[\frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t|s_{t+1} - f_{t+1}|^{p-1}\right]}, \tag{2}$$

where $\hat{S} = \frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t v_t'(I(s_{t+1} - f_{t+1} < 0) - \hat{\alpha})^2|s_{t+1} - f_{t+1}|^{2p-2}$ denotes a weighting matrix, v_t denotes a vector of instruments, T denotes the number of forecasts available, starting at $t = \tau+1$. With the weighting matrix depending on $\hat{\alpha}$, estimation is done by iterating between the right-hand side and the left-hand side of Equation (2). Testing whether $\hat{\alpha}$ differs from α_0 is done by using the following z-test: $\sqrt{T}(\hat{\alpha} - \alpha_0) \rightarrow \mathcal{N}(0, (\hat{h}'\hat{S}^{-1}\hat{h})^{-1})$, where $\hat{h} = \frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t|s_{t+1} - f_{t+1}|^{p-1}$. We consider as instruments a constant (Model 1), and a constant and the lagged exchange rate (Model 2).

Elliott *et al.* (2005) further show that a test for rationality of forecasts, given a loss function of the lin-lin or a quad-quad type ($p = 1, 2$), can be performed by computing

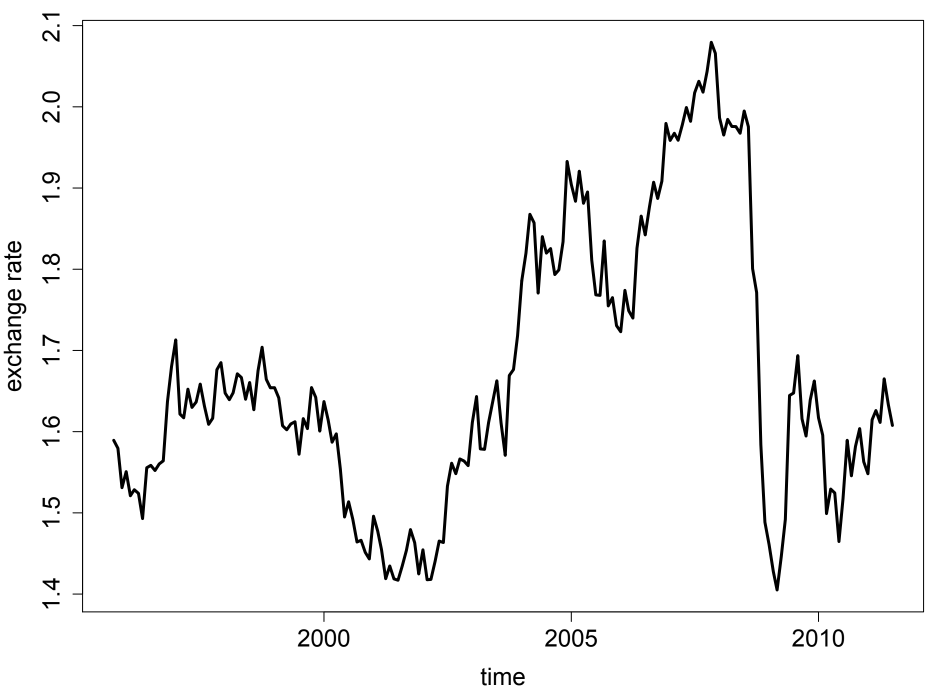
$$J(\hat{\alpha}) = \frac{1}{T}\left(x_t'\hat{S}^{-1}x_t\right) \sim \chi^2_{d-1}, \tag{3}$$

where $x_t = \sum_{t=\tau}^{T+\tau-1} v_t[I(s_{t+1} - f_{t+1} < 0) - \hat{\alpha}]|s_{t+1} - f_{t+1}|^{p-1}$ and $d =$ number of instruments. The rationality test is given by $J(0.5) \sim \chi^2_d$ if the loss function is symmetric. The statistic $J(0.5)$ renders it possible to study whether forecasters, under the maintained assumption of a symmetric loss function, form rational exchange-rate forecasts. The statistic $J(\hat{\alpha})$, answers the question of whether forecasters form rational forecasts, given an estimated asymmetric loss function (lin-lin or quad-quad). A comparison of $J(\hat{\alpha})$ with $J(0.5)$ shows whether an asymmetric loss function helps to remedy a potential failure of rationality of forecasts observed under a symmetric loss function.

3. Empirical Analysis

We use survey data on one-month-ahead and three-months-ahead forecasts of the dollar/British pound exchange rate compiled by Consensus Forecasts Inc. to study the shape of forecasters' loss function. Because not all forecasters participated in all surveys, the survey data are available in the form of an unbalanced panel. In our empirical analysis, we only consider forecasters who participated at least 50 times in the survey, which applies to 18 forecasters. In total, we use more than 5,000 forecasts. The forecasts are available for the sample period 1995/10−2011/7. Studying this sample period is interesting because, as Figure 1 witnesses, the dollar/British pound exchange rate experienced large swings, but also sharp trend reversals during our sample period. Because of the trend reversals we assume that the exchange rate can be treated as being stationary during the sample period that we study. The alternative would be to perform our analysis in terms of growth rates (see, for example, Auffhammer 2007). Forecasters, however, forecast the level, not the growth rate of the exchange rate.

Figure 1: The Data



Note: The figure shows the dollar/British pound exchange rate. We computed this figure and all other empirical results reported in this paper using the program R (R Development Core Team 2010).

Table I: Asymmetry parameter, lin-lin loss function

Panel A: One-month-ahead forecasts

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
1	73	0.5342	0.0584	0.5866	0.5375	0.0584	0.6433
2	64	0.4375	0.0620	-1.0079	0.4360	0.0620	-1.0322
3	76	0.4737	0.0573	-0.4595	0.4733	0.0573	-0.4666
4	72	0.4444	0.0586	-0.9487	0.4444	0.0586	-0.9490
5	78	0.4359	0.0561	-1.1417	0.4341	0.0561	-1.1749
6	63	0.5238	0.0629	0.3784	0.5239	0.0629	0.3805
7	71	0.4225	0.0586	-1.3214	0.4204	0.0586	-1.3590
8	73	0.4110	0.0576	-1.5463	0.4109	0.0576	-1.5471
9	76	0.4474	0.0570	-0.9228	0.4417	0.0570	-1.0233
10	59	0.5424	0.0649	0.6533	0.5429	0.0649	0.6616
11	67	0.4776	0.0610	-0.3669	0.4769	0.0610	-0.3782
12	61	0.4754	0.0639	-0.3846	0.4751	0.0639	-0.3894
13	56	0.4643	0.0666	-0.5359	0.4639	0.0666	-0.5420
14	79	0.5316	0.0561	0.5637	0.5337	0.0561	0.6007
15	78	0.6154	0.0551	2.0946	0.6203	0.0550	2.1889
16	77	0.3766	0.0552	-2.2343	0.3741	0.0551	-2.2837
17	59	0.3898	0.0635	-1.7351	0.3733	0.0630	-2.0124
18	80	0.3500	0.0533	-2.8128	0.3444	0.0531	-2.9293

Panel B: Three-months-ahead forecasts

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
1	73	0.5205	0.0585	0.3514	0.5264	0.0584	0.4517
2	64	0.4688	0.0624	-0.5010	0.4675	0.0624	-0.5208
3	75	0.5200	0.0577	0.3467	0.5201	0.0577	0.3488
4	71	0.3521	0.0567	-2.6090	0.3405	0.0562	-2.8363
5	78	0.4744	0.0565	-0.4535	0.4744	0.0565	-0.4535
6	68	0.5000	0.0606	0.0000	0.5000	0.0606	0.0000
7	73	0.4795	0.0585	-0.3514	0.4785	0.0585	-0.3679
8	72	0.3611	0.0566	-2.4536	0.3607	0.0566	-2.4623
9	76	0.5000	0.0574	0.0000	0.5000	0.0574	0.0000
10	58	0.4138	0.0647	-1.3330	0.4101	0.0646	-1.3924
11	66	0.5303	0.0614	0.4933	0.5322	0.0614	0.5239
12	72	0.4722	0.0588	-0.4721	0.4719	0.0588	-0.4779
13	56	0.3750	0.0647	-1.9322	0.3715	0.0646	-1.9894
14	78	0.4359	0.0561	-1.1417	0.4329	0.0561	-1.1963
15	77	0.5195	0.0569	0.3421	0.5195	0.0569	0.3422
16	76	0.3816	0.0557	-2.1252	0.3722	0.0554	-2.3054
17	59	0.4576	0.0649	-0.6533	0.4568	0.0649	-0.6667
18	79	0.3671	0.0542	-2.4509	0.3568	0.0539	-2.6560

Note: se = standard error, z-test = test of the null hypothesis that $\hat{\alpha} = 0.5$. Instruments = a constant (Model 1), a constant and the lagged exchange rate (Model 2).

Table II: Asymmetry parameter, quad-quad loss function

Panel A: One-month-ahead forecasts

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
1	73	0.5222	0.0889	0.2493	0.5400	0.0876	0.4564
2	64	0.5660	0.0955	0.6913	0.5676	0.0953	0.7097
3	76	0.5171	0.0903	0.1898	0.5202	0.0901	0.2244
4	72	0.4234	0.0880	-0.8701	0.4245	0.0879	-0.8589
5	78	0.4999	0.0936	-0.0005	0.5068	0.0930	0.0729
6	63	0.5036	0.0839	0.0428	0.5082	0.0832	0.0984
7	71	0.4601	0.1003	-0.3981	0.4591	0.1003	-0.4080
8	73	0.4278	0.0998	-0.7242	0.4201	0.0996	-0.8015
9	76	0.5490	0.0800	0.6124	0.5545	0.0796	0.6845
10	59	0.5149	0.0988	0.1506	0.5158	0.0987	0.1604
11	67	0.4939	0.0859	-0.0707	0.5245	0.0844	0.2900
12	61	0.5232	0.0923	0.2520	0.5356	0.0916	0.3892
13	56	0.4038	0.1042	-0.9227	0.4035	0.1042	-0.9256
14	79	0.5090	0.0876	0.1022	0.5221	0.0868	0.2546
15	78	0.5730	0.0841	0.8677	0.5882	0.0823	1.0716
16	77	0.3570	0.0855	-1.6728	0.3096	0.0846	-2.2497
17	59	0.4371	0.1059	-0.5940	0.4366	0.1060	-0.5987
18	80	0.4249	0.0926	-0.8105	0.4005	0.0936	-1.0630

Panel B: Three-months-ahead forecasts

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
1	73	0.5290	0.0770	0.3768	0.5554	0.0759	0.7297
2	64	0.4570	0.0814	-0.5291	0.4599	0.0812	-0.4934
3	75	0.4671	0.0751	-0.4385	0.4548	0.0735	-0.6148
4	71	0.2893	0.0680	-3.0973	0.2532	0.0641	-3.8512
5	78	0.4577	0.0807	-0.5238	0.4183	0.0768	-1.0642
6	68	0.4130	0.0780	-1.1151	0.4117	0.0766	-1.1533
7	73	0.4242	0.0780	-0.9728	0.4143	0.0772	-1.1095
8	72	0.3482	0.0800	-1.8965	0.2646	0.0669	-3.5183
9	76	0.5475	0.0712	0.6676	0.5570	0.0707	0.8065
10	58	0.3369	0.0766	-2.1295	0.3369	0.0766	-2.1296
11	66	0.5127	0.0815	0.1563	0.4837	0.0808	-0.2015
12	72	0.4326	0.0882	-0.7638	0.3356	0.0815	-2.0179
13	56	0.2890	0.0694	-3.0410	0.2855	0.0686	-3.1273
14	78	0.4933	0.0776	-0.0859	0.4554	0.0763	-0.5841
15	77	0.5315	0.0803	0.3919	0.5550	0.0794	0.6927
16	76	0.3607	0.0750	-1.8565	0.2594	0.0609	-3.9527
17	59	0.4438	0.0876	-0.6414	0.3820	0.0827	-1.4265
18	79	0.4120	0.0771	-1.1421	0.3186	0.0708	-2.5630

Note: se = standard error, z-test = test of the null hypothesis that $\hat{\alpha} = 0.5$. Instruments = a constant (Model 1), a constant and the lagged exchange rate (Model 2).

Tables I–II summarize the estimates of the asymmetry parameter, $\hat{\alpha}$, the corresponding standard error, and the z-test of the null hypothesis $\hat{\alpha} = \alpha_0 = 0.5$. The general message conveyed by Tables I–II is that the majority of forecasters seems to form forecasts under a symmetric loss function. Only four (five) forecasters seem to form forecasts under an asymmetric loss function in the case of one-month-ahead (three-months-ahead) forecasts for the case of the lin-lin loss function. The results for the quad-quad loss function are qualitatively similar. There is evidence of an asymmetric loss function for one forecaster only in the case of one-month-ahead forecasts. In the case of three-months-ahead forecasts, forecasts are consistent with an asymmetric quad-quad loss function in only five cases.

Table III: Tests of Forecast Rationality

No.	Loss function, forecast horizon	$J(0.5)$	p-value	$J(\hat{\alpha})$	p-value
15	Lin-lin, one-month	5.6602	0.0590	1.5960	0.2065
16	Lin-lin, one-month	5.4143	0.0667	0.7834	0.3761
17	Lin-lin, one-month	6.5221	0.0383	3.9213	0.0477
18	Lin-lin, one-month	8.6998	0.0129	1.4560	0.2276
4	Lin-lin, three-months	8.5957	0.0136	2.6288	0.1049
8	Lin-lin, three-months	5.6667	0.0588	0.1172	0.7321
9	Lin-lin, three-months	3.0833	0.2140	3.0833	0.0791
16	Lin-lin, three-months	6.8734	0.0322	2.8263	0.0927
18	Lin-lin, three-months	8.5318	0.0140	2.8628	0.0907
16	Quad-quad, one-month	5.7074	0.0576	4.5123	0.0337
4	Quad-quad, three-months	7.8942	0.0193	3.3292	0.0681
8	Quad-quad, three-months	8.3597	0.0153	4.5293	0.0333
10	Quad-quad, three-months	3.5349	0.1708	0.0172	0.8955
13	Quad-quad, three-months	6.4102	0.0406	0.1360	0.7123
16	Quad-quad, three-months	10.4348	0.0054	7.0615	0.0079

Note: $J(0.5)$ denotes the J-test for a symmetric loss function. $J(\hat{\alpha})$ denotes the J-test for an estimated (unconstrained) lin-lin or quad-quad loss function. Instruments = a constant and the lagged exchange rate (Model 2).

Table III summarizes the results of the J-test of forecast rationality. We focus on those exchange-rate forecasters whose forecasts are consistent with an asymmetric loss function according to the estimated $\hat{\alpha}$ parameter. The general picture that emerges is that assuming an asymmetric loss function tends to increase the p-value of the J-test, making many (but not all) test results insignificant at the 5% level of significance. The lin-lin loss function performs somewhat better than the quad-quad loss function in terms of forecast rationality. For the lin-lin loss function, only one out of nine tests is significant (at the 5% level of significance). For the quad-quad loss function, three out of six tests are significant. Under a quad-quad loss function it, thus, is more difficult to maintain the hypothesis of forecast rationality even under an asymmetric loss function.

4. Concluding Remarks

Our empirical results imply that, in the case of the dollar/British pound exchange rate, only few forecasters seem to form exchange-rate forecasts under an asymmetric loss function. For those forecasters whose exchange-rate forecasts provide signs of an asymmetric loss function, however, erroneously assuming a symmetric loss function often results in rejection of forecast rationality. In contrast, assuming asymmetry of the loss function often (but not always) makes forecasts look rational. In this respect, our results for the dollar/British pound exchange rate resemble results reported in earlier literature on forecasting under asymmetric loss (Elliott *et al.* 2005, Auffhammer 2007, Christodoulakis and Mamatzakis 2008b, Pierdzioch et al. 2012).

In future empirical research, it is interesting to explore whether the results we have reported for the dollar/British pound exchange rate also apply in the case of other exchange rates. For example, it is interesting to study whether an asymmetric loss function is useful to describe the properties of forecasts of exchange rates of emerging market economies. It is also interesting to explore whether accounting for an asymmetric loss function is important for rationality tests in the case of other asset prices. Finally, it is interesting to use other empirical approaches than the one we have used in this note to study asymmetric loss functions of exchange-rate forecasters.

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