Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Department Socioeconomics

Forecasting the Euro: Do Forecasters Have an Asymmetric Loss Function?

Ulrich Fritsche
Christian Pierdzioch
Jan-Christoph Rülke
Georg Stadtmann

DEP (Socioeconomics) Discussion Papers
Macroeconomics and Finance Series
1/2012

Hamburg, 2012

Forecasting the Euro:
Do Forecasters Have an Asymmetric Loss Function?

December 2011

Abstract

Based on the approach advanced by Elliott et al. (Rev. Ec. Studies. 72, 1197−1125, 2005), we analyzed whether the loss function of a sample of exchange rate forecasters is asymmetric in the forecast error. Using forecasts of the euro/dollar exchange rate, we found that the shape of the loss function varies across forecasters. Our empirical results suggest that it is important to account for the heterogeneity of exchange rate forecasts at the microeconomic level of individual forecasters when one seeks to analyze whether forecasters form exchange rate forecasts under an asymmetric loss function.

JEL classification: F31, D84
Keywords: Exchange rate; Forecasting; Loss function

Addresses:

Ulrich Fritsche, University of Hamburg, Faculty of Economics and Social Sciences, Department Socio-Economics, Welckerstr. 8, 20354 Hamburg.

Corresponding author: Christian Pierdzioch, Helmut-Schmidt-University, Department of Economics, Holstenhofweg 85, P.O.B. 700822, 22008 Hamburg, Germany.

Jan-Christoph Rülke, Department of Economics, WHU – Otto Beisheim School of Management, Burgplatz 2, 56179 Vallendar, Germany.

Georg Stadtmann, University of Southern Denmark, Department of Business and Economics, Campusvej 55, 5230 Odense M, Denmark, and European-University Viadrina, Postfach 1786, 15207 Frankfurt (Oder), Germany, Tel. +49 335 5534 2700, Stadtmann@europa-uni.de

* Corresponding author.

We are grateful for the financial support received through the foundation "Geld and Währung" from the Deutsche Bundesbank (S126/10081/11).

1 Introduction

Because the way agents form their exchange rate forecasts plays a key role in modern models of exchange rate determination, much empirical research has been done to recover important characteristics of exchange rate forecasts. Many researchers have reported that one important characteristic of exchange rate forecasts is that they are not consistent with traditional criteria of forecast rationality (for a classic contribution, see Ito 1990). Another important characteristic of exchange rate forecasts is that a substantial degree of heterogeneity becomes apparent at the microeconomic level when one analyzes forecasts of individual forecasters (MacDonald and Marsh 1996, Benassy-Quere et al. 2003).

Traditional criteria of forecast rationality assume that forecasters have a symmetric and quadratic loss function. Assuming a quadratic loss function, however, may be problematic. In fact, recent research has provided evidence indicating that deviations from a quadratic loss function are quite common (see Elliott et al. (2005) for OECD and IMF forecasts, Christodoulakis and Mamatzakis (2008a) for forecasts of the European Commission, and Boero et al. (2008) for inflation forecasts). With regard to exchange rates, Christodoulakis and Mamatzakis (2008a) find that an asymmetric loss function may be better suited for the analysis of foreign exchange markets than a traditional symmetric loss function. They derive their finding using the forward exchange rate to measure exchange rate forecasts. The forward exchange rate, however, summarizes the market-wide exchange rate forecast and thus neglects the potentially important heterogeneity of exchange rate forecasts at the microeconomic level.

We used survey data on euro/dollar forecasts to recover potential asymmetries of forecasters' loss function at the microeconomic level. For a sample of more than 8,500 forecasts, we found that forecasters on average tend to incur higher losses when they underpredict the exchange rate than when they overpredict the exchange rate. For pooled data, this evidence in favor of an asymmetric loss function is stronger for twelve-months-ahead forecasts than for one-month-ahead forecasts, though the differences across forecast horizons are small for pooled data. At the microeconomic level, the shape of the loss function varies to a substantial extent across forecasters, where some forecasters seem to incur high losses when they overpredict the euro/dollar exchange rate, whilst other forecasters incur high losses when they underpredict the exchange rate. Many forecasters, however, deliver forecasts that are consistent with a symmetric loss function. Furthermore, there appears no clear-cut link between the shape of forecasters' loss function and the length of the forecast horizon. Christodoulakis and Mamatzakis (2008b), in contrast, report that, when one uses the forward rate to measure market-wide exchange rate forecasts, the loss function becomes more symmetric as the forecast horizon gets shorter. Results based on exchange rate forecasts at the microeconomic level, thus, might differ from results derived from market-wide exchange rate forecasts.

In order to analyze the shape of forecasters' loss function, we used an approach recently developed by Elliott et al. (2005), which has also been studied by Christodoulakis and Mamatzakis (2008b). This approach is easy to implement, it informs about the type of a potential asymmetry in forecasters' loss function, and it allows the rationality of forecasts under an asymmetric loss function to be tested. In Section 2, we briefly outline the approach developed by Elliott et al. (2005). In Section 3, we describe our data and our empirical results. In Section 4, we offer some concluding remarks.

2 Theoretical Background

The approach developed by Elliott et al. (2005) rests on the assumption that a forecaster's loss function, $\mathcal{L}$ can be described in terms of the following general functional form:

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

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. In the case of $\alpha = 0.5$, the loss function is symmetric. For $\alpha = 0.5$ and $p = 2$, the loss a forecaster increases in the squared forecast error. For $\alpha = 0.5$ and $p = 1$, the loss increases in the absolute forecast error.

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 $t = \tau + 1$. Because the weighting matrix depends on $\hat{\alpha}$, estimation is done iteratively. Testing whether $\hat{\alpha}$ differs from α_0 is done by using the following z-test $\sqrt{T}(\hat{\alpha} - \alpha_0) \to \mathcal{N}(0, (\hat{h}'\hat{S}^{-1}\hat{h})^{-1})$, where $\hat{h} = \frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t |s_{t+1} - f_{t+1}|^{p-1}$.

We considered as instruments a constant (Model 1), and a constant and lagged exchange rate (Model 2). Because the survey data that we shall describe in Section 3 below contains forecasts for an unbalanced panel of forecasters, we did not follow Elliott et al. (2005) in using lagged published forecasts as another instrument.

Testing whether $\hat{\alpha}$ differs from α_0 is done by using the following z-test $\sqrt{T}(\hat{\alpha} - \alpha_0) \to \mathcal{N}(0, (\hat{h}'\hat{S}^{-1}\hat{h})^{-1})$, where $\hat{h} = \frac{1}{T}\sum_{t=\tau}^{T+\tau-1} v_t |s_{t+1} - f_{t+1}|^{p-1}$. Elliott et al. (2005) further prove 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 denotes the number of instruments. In the case of a symmetric loss function, the rationality test is given by $J(0.5) \sim \chi^2_d$. The statistic $J(0.5)$ answers the question of 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 (unconstrained) 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

In order to recover, at the microeconomic level, a potential asymmetry in forecasters' loss function, we used survey data on one-month-ahead, three-months-ahead, and twelve-months-ahead forecasts of the euro/dollar exchange rate compiled by Consensus Forecasts Inc. The survey data contain information on individual exchange rate forecasts issued by forecasters who work for institutions such as investment banks, large international corporations, economic research institutes, and at universities. 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 considered forecasters who participated at least 20 times in the survey (31 forecasters). The survey data are available at a monthly frequency for the period 1999/1−2011/7. In total, we could use 2,927 one-month-ahead forecasts, 2,940 three-months-ahead forecasts, and 2,747 twelve-months-ahead forecasts.

– Please insert Figure 1 about here. –

Figure 1 illustrates the properties of the data. We used the program R to compute this figure and all other results documented in this paper (R Development Core Team 2010).

The figure shows that the cross-sectional average of forecasts (solid line) across individual forecasts closely tracked the euro/dollar exchange rate (dashed line). More interesting is the shaded area, which highlights that, at the microeconomic level, individual forecasts showed a substantial degree of cross-forecaster heterogeneity. The shaded area is defined as the cross-sectional range between the maximum and the minimum exchange rate forecast. Given the heterogeneity of forecasts, one would expect a substantial extent of cross-sectional variation in the asymmetry parameter, $\hat{\alpha}$, across forecasters.

– Please include Table 1 about here. –

Table 1 summarizes the results of a Wilcoxon test of the null hypothesis that the distribution of forecast errors is symmetric around zero. Again, a substantial cross-sectional variation becomes evident. While for some forecasters the null hypothesis cannot be rejected, a symmetric distribution seems to fit the forecast errors made by other forecasters less well. The test results are significant for forecasters 5, 15, 19, 28, 30, and 31 in the case of one-month-ahead forecasts, suggesting that these forecasters may form forecasts under an asymmetric loss function. Similarly, for three-months-ahead forecasts and twelve-months-ahead forecasts, the results of a Wilcoxon test (not reported for the sake of brevity) also yield evidence of an asymmetric distribution of forecast errors for some forecasters, but not for others. We, thus, expect also for longer term forecasts a substantial cross-sectional heterogeneity with respect to the shape of forecasters' loss function.

– Please include Table 2 about here. –

Table 2 presents results for pooled data to alleviate a comparison of our results with the results documented by Christodoulakis and Mamatzakis (2008b). The point estimates of the asymmetry parameter, $\hat{\alpha}$, tend to become smaller as the forecasting horizon gets longer. The differences across forecast horizons, however, appear to be small and statistically insignificant. The weak link between the magnitude of the estimates of the asymmetry parameter, $\hat{\alpha}$, and the length of the forecasting horizon is in contrast to results reported by Christodoulakis and Mamatzakis (2008b). Using forward exchange rates to measure market-wide forecasts of the euro/dollar exchange rate, they report $\hat{\alpha} = 0.4207$ for weekly data and $\hat{\alpha} = 0.3860$ for monthly data in case of a lin-lin loss function. For a quad-quad loss function, they report $\hat{\alpha} = 0.4089$ for weekly data and $\hat{\alpha} = 0.2846$ for monthly data. Their results thus imply that the point estimates of the asymmetry parameter of the loss function become significantly smaller as the forecast horizon increases, implying that the asymmetry of the loss function gets more pronounced for longer forecasting horizons.

– Please include Table 3−5 about here. –

Tables 3−5 summarize, for every forecaster, 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 loss function is of the lin-lin type. The results for a quad-quad loss function are similar. They are not reported but available upon request. The general message conveyed by the estimates of the asymmetry parameter, $\hat{\alpha}$, is that there is quite some heterogeneity across forecasters with respect to the shape of the loss function, irrespective of whether one uses a lin-lin loss function or a quad-quad loss function. Many forecasters deliver forecasts that are consistent with a symmetric loss function. Furthermore, there appears no clear-cut link between the shape of forecasters' loss function and the length of the forecast horizon.

– Please include Table 6 about here. –

Table 6 summarizes the results of the J test of forecast rationality for pooled data. Again, we present the results for the pooled data to make it easy for a reader to compare our results with the results documented by Christodoulakis and Mamatzakis (2008b). Assuming an asymmetric loss function tends to lead to a nonrejection of the hypothesis of rational forecasts for twelve-months-ahead forecasts, but the results depend on whether one assumes a lin-lin loss function or a quad-quad loss function.

– Please include Table 7−9 about here. –

Tables 7−9 summarize the results we obtained when we studied at the microeconomic level the forecasts of individual forecasters. The results shown in the tables are for a lin-lin loss function (the results for a quad-quad loss function are similar and available upon request). For many forecasters, the hypothesis of rational forecasts cannot be rejected, irrespective of the symmetry or asymmetry of the assumed loss function. For a few forecasters, the assumption of an asymmetric loss function makes their forecasts look rational. For other forecasters, however, forecast rationality can be rejected irrespective of the assumed loss function.

Those forecasters for which the J-test yields results in a rejection of forecast rationality irrespective of the assumed loss function may indeed form irrational forecasts that are not orthogonal to information in their information set. Another possibility, however, is that these forecasters form rational forecasts, but that the process of forecasting the euro/dollar exchange rate is more complex than implied by the lin-lin (or the quad-quad) loss function. For example, strategic interactions among forecasters may lead forecasters to publish forecasts that intentionally deviate from the forecasts of others. Empirical evidence of such "anti-herding" of exchange rate forecasters has been reported by Pierdzioch and Stadtmann (2011). If forecasters anti-herd, their loss function is likely to deviate from a simple symmetric (quadratic) loss function (Laster et al. 1999) and, thus, rational forecasts violate traditional rationality criteria, which are based on a quadratic loss function. If anti-herding, however, reflects deviations from a symmetric loss function, it is not necessarily the case that a loss function of the lin-lin or the quad-quad form suffice to fully account for such deviations.

4 Concluding Remarks

Our empirical results suggest that it is important to account for the heterogeneity of exchange rate forecasts at the microeconomic level of individual forecasters when one seeks to analyze whether individual forecasters form exchange rate forecasts under an asymmetric loss function. As for the loss function of a "representative" forecaster, the analysis of pooled data or forward rates as measures of market-wide exchange rate expectations is likely to provide important insights. Our results, however, suggest that studying market-wide information to recover the shape of the loss function of individual forecasters is likely to cloud a substantial cross-sectional heterogeneity with respect to the shape of the loss function at the microeconomic level. While the assumption of a representative forecaster often suffices to set up macroeconomic models of exchange rate determination, our results imply that, when researchers seek to test behavioral theories of exchange rate dynamics, accounting for the cross-sectional heterogeneity of forecasters can help to recover, at least when the euro/dollar exchange rate is being studied, interesting new phenomena.

References

Benassy-Quere, A., Larribeau, S. and MacDonald, R. (2003). 'Models of Exchange Rate Expectations: How Much Heterogeneity?', Journal of International Financial Markets, Institutions and Money, Vol. 13, pp. 113−136.

Boero, G., Smith, J. and Wallis, K.F. (2010). 'Evaluating a Three-Dimensional Panel of Point Forecasts: the Bank of England Survey of External Forecasters', International Journal of Forecasting, Vol. 24, pp. 354−367.

Christodoulakis, G.A. and Mamatzakis, E.C. (2008a).' Assessing the Prudence of Economic Forecasts in the EU', Journal of Applied Econometrics, Vol. 24, pp. 583−606.

Christodoulakis, G.A. and Mamatzakis, E.C. (2008b). 'Behavioural Asymmetries in the Spot-Forward G10 Exchange Rates: Answering an Old Puzzle'. Working Paper 2008-12, University of Macedonia, Thessaloniki.

Elliott,G., Komunjer, I. and Timmermann, A. (2005). 'Estimation and Testing of Forecast Rationality under Flexible Loss', Review of Economics Studies, Vol. 72, pp. 1107−1125.

Ito, T. (1990). 'Foreign Exchange Expectations: Micro Survey Data', American Economic Review, Vol. 80, pp. 434−449.

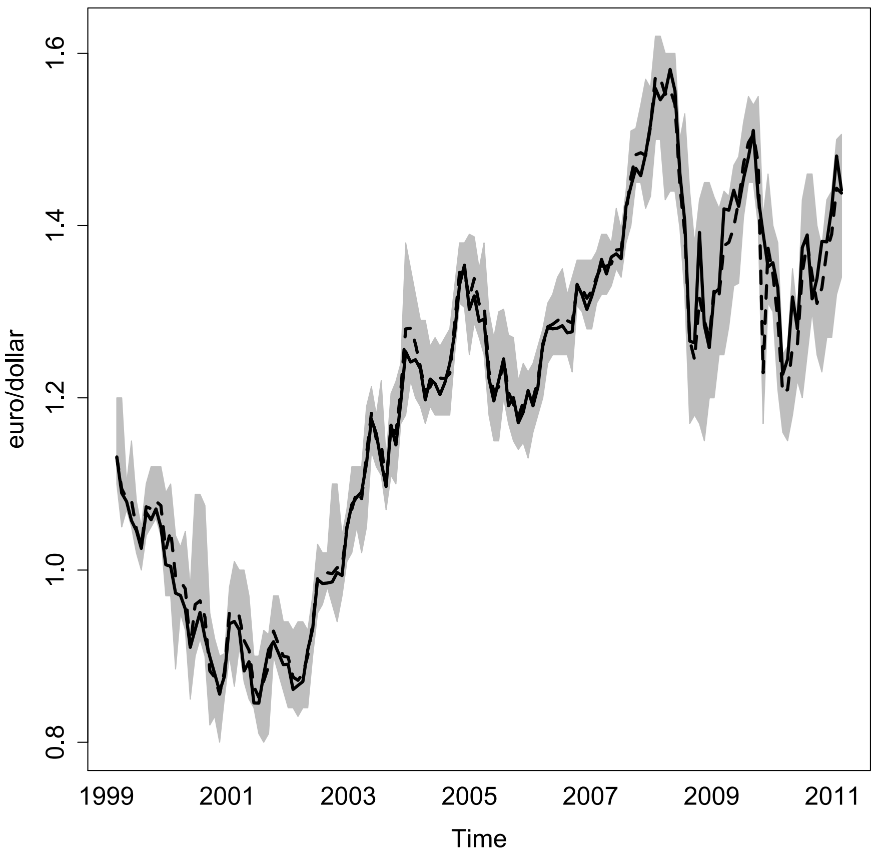
Laster, D., Bennett, P. and Geoum,I.S. (1999). 'Rational Bias in Macroeconomic Forecasts', Quarterly Journal of Economics, Vol. 114, pp. 293−318.

MacDonald, R. and Marsh, I.W. (1996). 'Currency Forecasters are Heterogeneous: Confirmation and Consequences', Journal of International Money and Finance, Vol. 15, pp. 665−685.

Pierdzioch, C. and Stadtmann, G.(2010). 'Do Exchange Rate Forecasters Herd?', Applied Economics Letters, Vol. 18, pp. 739−741.

R Development Core Team (2010). 'R: A Language and Environment for Statistical Computing', R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0. Internet address: http://www.R-project.org. Download: April 2010 (Version 2.10.1).

Figure 1: The Data



Note: The solid line shows the exchange rate. The dashed line shows the (lagged) cross-sectional mean forecast. The shaded area shows the range of forecasts.

Table 1: Results of the Wilcoxon Test (One-Month-Ahead Forecasts)

No.	Obs.	Test	p-value
1	119	3138	0.2525
2	104	3009	0.3665
3	144	5251	0.9515
4	129	3653	0.2052
5	39	510	0.0957
6	26	204	0.4834
7	21	109	0.8382
8	79	1714	0.5141
9	147	4969	0.3639
10	107	2947	0.8582
11	129	3776	0.3281
12	57	939	0.3735
13	140	5287	0.4647
14	96	2354	0.9258
15	140	4071	0.0725
18	137	4721	0.9914
19	132	3407	0.0258
20	133	3991	0.2974
21	111	3203	0.7810
23	106	3249	0.1930
24	139	4819	0.9238
25	146	4830	0.2959
26	124	4276	0.3179
27	66	912	0.2176
28	132	5290	0.0408
29	144	5138	0.8709
30	27	265	0.0692
31	23	201	0.0563

Note: The null hypothesis is that the distribution of forecast errors is symmetric around zero.

Table 2: Results for pooled data

Panel A: One-month-ahead forecasts, lin-lin loss function

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
All	2927	0.5091	0.0092	0.9798	0.5091	0.0092	0.9877

Panel B: Three-months-ahead forecasts, lin-lin loss function

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
All	2940	0.4803	0.0092	-2.141	0.48	0.0092	-2.1659

Panel C: Twelve-months-ahead forecasts, lin-lin loss function

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
All	2747	0.4751	0.0095	-2.6172	0.4751	0.0095	-2.618

Panel D: One-month-ahead forecasts, quad-quad loss function

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
All	2927	0.4958	0.0123	-0.3458	0.5018	0.0121	0.1511

Panel E: Three-months-ahead forecasts, quad-quad loss function

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
All	2940	0.5007	0.0117	0.0571	0.5058	0.0115	0.5045

Panel F: Twelve-months-ahead forecasts, quad-quad loss function

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
All	2747	0.4889	0.0114	-0.9715	0.4874	0.0114	-1.1032

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

Table 3: Asymmetry parameter, lin-lin loss function, one-month-ahead forecasts

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
1	119	0.5630	0.0455	1.3861	0.5632	0.0455	1.3905
2	104	0.4808	0.0490	-0.3925	0.4799	0.0490	-0.4094
3	144	0.4653	0.0416	-0.8354	0.4653	0.0416	-0.8357
4	129	0.5736	0.0435	1.6913	0.5737	0.0435	1.6916
5	39	0.3590	0.0768	-1.8360	0.3584	0.0768	-1.8442
6	26	0.4615	0.0978	-0.3934	0.4594	0.0977	-0.4159
7	21	0.6667	0.1029	1.6202	0.7443	0.0952	2.5663
8	79	0.5063	0.0562	0.1125	0.5064	0.0562	0.1143
9	147	0.5238	0.0412	0.5780	0.5241	0.0412	0.5840
10	107	0.5140	0.0483	0.2901	0.5142	0.0483	0.2937
11	129	0.5349	0.0439	0.7943	0.5381	0.0439	0.8680
12	57	0.4737	0.0661	-0.3979	0.4736	0.0661	-0.3997
13	140	0.4714	0.0422	-0.6772	0.4713	0.0422	-0.6813
14	96	0.4583	0.0509	-0.8193	0.4582	0.0509	-0.8211
15	140	0.5429	0.0421	1.0179	0.5476	0.0421	1.1325
18	137	0.4818	0.0427	-0.4275	0.4817	0.0427	-0.4285
19	132	0.5985	0.0427	2.3082	0.5985	0.0427	2.3083
20	133	0.5714	0.0429	1.6646	0.5720	0.0429	1.6779
21	111	0.4685	0.0474	-0.6657	0.4585	0.0473	-0.8768
23	106	0.4340	0.0481	-1.3718	0.4331	0.0481	-1.3908
24	139	0.5180	0.0424	0.4244	0.5181	0.0424	0.4280
25	146	0.5616	0.0411	1.5011	0.5652	0.0410	1.5902
26	124	0.4758	0.0448	-0.5394	0.4754	0.0448	-0.5480
27	66	0.5455	0.0613	0.7416	0.5464	0.0613	0.7575
28	132	0.4242	0.0430	-1.7611	0.4239	0.0430	-1.7685
29	144	0.5139	0.0417	0.3335	0.5139	0.0417	0.3340
30	27	0.2963	0.0879	-2.3180	0.2748	0.0859	-2.6212
31	23	0.3043	0.0959	-2.0392	0.2737	0.0930	-2.4338

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

Table 4: Asymmetry parameter, lin-lin loss function, three-months-ahead forecasts

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
1	117	0.5470	0.0460	1.0215	0.5478	0.0460	1.0387
2	114	0.5000	0.0468	0.0000	0.5000	0.0468	0.0000
3	142	0.4437	0.0417	-1.3513	0.4422	0.0417	-1.3868
4	127	0.5433	0.0442	0.9798	0.5433	0.0442	0.9805
6	24	0.2917	0.0928	-2.2454	0.2891	0.0925	-2.2792
7	22	0.6364	0.1026	1.3296	0.6940	0.0983	1.9742
8	80	0.4125	0.0550	-1.5898	0.4121	0.0550	-1.5966
9	145	0.4483	0.0413	-1.2524	0.4460	0.0413	-1.3079
10	110	0.4091	0.0469	-1.9392	0.4076	0.0469	-1.9716
11	128	0.5547	0.0439	1.2449	0.5561	0.0439	1.2773
12	57	0.4737	0.0661	-0.3979	0.4727	0.0661	-0.4123
13	138	0.4203	0.0420	-1.8970	0.4200	0.0420	-1.9035
14	94	0.5213	0.0515	0.4129	0.5228	0.0515	0.4429
15	138	0.6014	0.0417	2.4341	0.6079	0.0416	2.5961
18	135	0.4296	0.0426	-1.6517	0.4290	0.0426	-1.6670
19	130	0.5231	0.0438	0.5268	0.5231	0.0438	0.5271
20	135	0.5556	0.0428	1.2990	0.5556	0.0428	1.2994
21	110	0.3909	0.0465	-2.3448	0.3531	0.0456	-3.2227
23	104	0.3558	0.0469	-3.0723	0.3555	0.0469	-3.0778
24	137	0.4380	0.0424	-1.4637	0.4368	0.0424	-1.4916
25	144	0.5139	0.0417	0.3335	0.5151	0.0416	0.3628
26	124	0.4355	0.0445	-1.4490	0.4352	0.0445	-1.4551
27	68	0.5882	0.0597	1.4784	0.5883	0.0597	1.4788
28	131	0.4046	0.0429	-2.2252	0.4042	0.0429	-2.2344
29	143	0.4965	0.0418	-0.0836	0.4965	0.0418	-0.0836
30	25	0.3600	0.0960	-1.4583	0.2918	0.0909	-2.2906
31	21	0.1905	0.0857	-3.6122	0.0364	0.0409	-11.3488

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

Table 5: Asymmetry parameter, lin-lin loss function, twelve-months-ahead forecasts

No.	Obs.	$\hat{\alpha}_{Model1}$	se	z-test	$\hat{\alpha}_{Model2}$	se	z-test
1	110	0.5000	0.0477	0.0000	0.5000	0.0477	0.0000
2	105	0.4286	0.0483	-1.4790	0.4236	0.0482	-1.5850
3	133	0.3534	0.0414	-3.5372	0.3515	0.0414	-3.5863
4	123	0.4959	0.0451	-0.0902	0.4959	0.0451	-0.0902
5	66	0.4545	0.0613	-0.7416	0.4250	0.0608	-1.2328
7	22	0.8636	0.0732	4.9701	0.9967	0.0122	40.6946
8	77	0.4545	0.0567	-0.8010	0.4462	0.0566	-0.9498
9	137	0.3869	0.0416	-2.7190	0.3865	0.0416	-2.7284
10	102	0.3725	0.0479	-2.6623	0.3651	0.0477	-2.8307
11	122	0.5574	0.0450	1.2759	0.5624	0.0449	1.3890
12	57	0.5789	0.0654	1.2072	0.6415	0.0635	2.2275
13	129	0.3876	0.0429	-2.6204	0.3777	0.0427	-2.8643
14	85	0.5765	0.0536	1.4268	0.5883	0.0534	1.6545
15	130	0.6308	0.0423	3.0895	0.6322	0.0423	3.1246
18	126	0.4127	0.0439	-1.9905	0.4126	0.0439	-1.9925
19	122	0.4508	0.0450	-1.0917	0.4494	0.0450	-1.1239
20	127	0.5039	0.0444	0.0887	0.5042	0.0444	0.0957
21	102	0.3333	0.0467	-3.5707	0.3333	0.0467	-3.5707
23	95	0.3368	0.0485	-3.3647	0.3299	0.0482	-3.5273
24	129	0.4341	0.0436	-1.5099	0.4337	0.0436	-1.5193
25	135	0.4074	0.0423	-2.1895	0.4022	0.0422	-2.3179
26	118	0.5085	0.0460	0.1841	0.5085	0.0460	0.1853
27	64	0.5156	0.0625	0.2501	0.5167	0.0625	0.2681
28	122	0.5328	0.0452	0.7258	0.5334	0.0452	0.7389
29	134	0.5522	0.0430	1.2161	0.5535	0.0429	1.2450

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

Table 6: J-test, lin-lin loss function, pooled data

Panel A: One-month-ahead forecasts, lin-lin loss function

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
All	2927	12.6112	0.0018	11.6722	0.0001

Panel B: Three-months-ahead forecasts, lin-lin loss function

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
All	2940	21.5126	0.0000	16.8861	0.0000

Panel C: Twelve-months-ahead forecasts, lin-lin loss function

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
All	2747	7.2508	0.0266	0.416	0.5189

Panel D: One-month-ahead forecasts, quad-quad loss function

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
All	2927	8.1484	0.017	8.3892	0.0038

Panel E: Three-months-ahead forecasts, quad-quad loss function

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
All	2940	8.3867	0.0151	8.4015	0.0037

Panel F: Twelve-months-ahead forecasts, quad-quad loss function

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
All	2747	24.5426	0.0000	23.4341	0.0000

Note: p = p-value. $J(0.5)$ denotes the J-test for a symmetric loss function. $J(\hat{\alpha})$ denotes the J-test for an estimated lin-lin loss function. The instruments used are a constant and the lagged exchange rate.

Table 7: J-test, lin-lin loss function, one-month-ahead forecasts

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
1	119	2.0756	0.3542	0.1840	0.6680
2	104	2.2872	0.3187	2.1420	0.1433
3	144	0.7227	0.6967	0.0275	0.8683
4	129	2.8098	0.2454	0.0111	0.9161
5	39	3.1674	0.2052	0.0807	0.7764
6	26	0.9015	0.6371	0.6985	0.4033
7	21	5.3776	0.0680	4.0021	0.0454
8	79	0.6135	0.7358	0.6037	0.4372
9	147	1.0840	0.5816	0.7527	0.3856
10	107	0.7310	0.6938	0.6436	0.4224
11	129	5.9054	0.0522	5.4514	0.0196
12	57	0.2852	0.8671	0.1303	0.7181
13	140	0.8801	0.6440	0.4205	0.5167
14	96	0.7719	0.6798	0.1035	0.7477
15	140	8.1282	0.0172	7.0398	0.0080
18	137	0.3558	0.8370	0.1721	0.6782
19	132	5.1232	0.0772	0.0021	0.9631
20	133	3.2451	0.1974	0.5191	0.4712
21	111	14.3353	0.0008	13.3444	0.0003
23	106	2.5793	0.2754	0.7098	0.3995
24	139	0.7561	0.6852	0.5822	0.4455
25	146	6.3402	0.0420	4.0303	0.0447
26	124	1.2613	0.5322	0.9619	0.3267
27	66	1.2175	0.5440	0.6870	0.4072
28	132	3.2928	0.1927	0.2704	0.6031
29	144	0.2263	0.8930	0.1154	0.7340
30	27	5.7175	0.0573	1.3510	0.2451
31	23	4.9921	0.0824	1.6648	0.1970

Note: p = p-value. $J(0.5)$ denotes the J-test for a symmetric loss function. $J(\hat{\alpha})$ denotes the J-test for an estimated lin-lin loss function. The instruments used are a constant and the lagged exchange rate.

Table 8: J-test, lin-lin loss function, three-months-ahead forecasts

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
1	117	2.0092	0.3662	0.9642	0.3261
2	114	1.5281	0.4658	1.5281	0.2164
3	142	3.6948	0.1576	1.7959	0.1802
4	127	1.0020	0.6059	0.0493	0.8243
5	66	1.0084	0.6040	1.0084	0.3153
6	24	4.3362	0.1144	0.1476	0.7008
7	22	5.2695	0.0717	3.6106	0.0574
8	80	2.6209	0.2697	0.1646	0.6850
9	145	4.5934	0.1006	3.0456	0.0810
10	110	4.4851	0.1062	0.8741	0.3498
11	128	3.0976	0.2125	1.6057	0.2051
12	57	1.1138	0.5730	0.9946	0.3186
13	138	3.7382	0.1543	0.2274	0.6334
14	94	3.2768	0.1943	3.1732	0.0749
15	138	9.6045	0.0082	4.1450	0.0418
18	135	3.2759	0.1944	0.6089	0.4352
19	130	0.3152	0.8542	0.0388	0.8438
20	135	1.6873	0.4301	0.0207	0.8857
21	110	20.8413	0.0000	14.8317	0.0001
23	104	8.7453	0.0126	0.0850	0.7706
24	137	3.3703	0.1854	1.2633	0.2610
25	144	5.9325	0.0515	5.8195	0.0158
26	124	2.3205	0.3134	0.2593	0.6106
27	68	2.1263	0.3454	0.0090	0.9245
28	131	5.0205	0.0812	0.2625	0.6084
29	143	0.0089	0.9955	0.0019	0.9649
30	25	6.4049	0.0407	4.6600	0.0309
31	21	12.5172	0.0019	17.7197	0.0000

Note: p = p-value. $J(0.5)$ denotes the J-test for a symmetric loss function. $J(\hat{\alpha})$ denotes the J-test for an estimated lin-lin loss function. The instruments used are a constant and the lagged exchange rate.

Table 9: J-test, lin-lin loss function, twelve-months-ahead forecasts

No.	Obs.	$J(0.5)$	p	$J(\hat{\alpha})$	p
1	110	0.7140	0.6998	0.7140	0.3981
2	105	5.6399	0.0596	3.4476	0.0633
3	133	12.3538	0.0021	0.8330	0.3614
4	123	0.0082	0.9959	0.0000	0.9947
5	66	12.6312	0.0018	13.2406	0.0003
7	22	15.1782	0.0005	121.8138	0.0000
8	77	6.7831	0.0337	5.9958	0.0143
9	137	7.2471	0.0267	0.2231	0.6367
10	102	9.2931	0.0096	2.8559	0.0910
11	122	6.4840	0.0391	4.9082	0.0267
12	57	17.6776	0.0001	13.5675	0.0002
13	129	12.0546	0.0024	5.2564	0.0219
14	85	6.9824	0.0305	5.7491	0.0165
15	130	9.5722	0.0083	0.6803	0.4095
18	126	3.9044	0.1420	0.0626	0.8025
19	122	2.9015	0.2344	1.7295	0.1885
20	127	4.6024	0.1001	4.5895	0.0322
21	102	11.3333	0.0035	0.0000	0.9992
23	95	12.4373	0.0020	1.9722	0.1602
24	129	2.6393	0.2672	0.3926	0.5310
25	135	8.4897	0.0143	3.6213	0.0570
26	118	0.4032	0.8174	0.3711	0.5424
27	64	2.2281	0.3282	2.1421	0.1433
28	122	1.5920	0.4511	1.0725	0.3004
29	134	3.0029	0.2228	1.5403	0.2146

Note: p = p-value. $J(0.5)$ denotes the J-test for a symmetric loss function. $J(\hat{\alpha})$ denotes the J-test for an estimated lin-lin loss function. The instruments used are a constant and the lagged exchange rate.