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Evaluating German Business Cycle Forecasts under an Asymmetric Loss Function

by
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Based on annual data for growth and inflation forecasts for Germany covering the 1970-2007 period and up to 17 different forecasts per year, we test for a possible asymmetry of the forecasters' loss function and estimate the degree of asymmetry for each forecasting institution using the approach of Elliot et al. *(2005). Furthermore, we test for the rationality of the forecasts under the assumption of a possibly asymmetric loss function and for the features of an optimal forecast under the assumption of a generalised loss function. We find evidence of the existence of an asymmetric loss function of German forecasters only in the case of pooled data and a quad-quad loss function. We can reject the hypothesis of rationality of the growth forecasts based on a pooled dataset, but not on data for single institutions. The rationality of inflation forecasts is frequently rejected in the case of single institutions, and also for pooled data.*

JEL Classification: C53, E42.

Keywords: business cycle forecast evaluation, asymmetric loss function, rational expectations.

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A central assumption in economics and finance is that economic agents behave rationally when they form their expectations. Consequently, a large body of literature has investigated the accuracy and rationality of forecasts, including several studies regarding German business cycle forecasts (see, *e.g.*, Fildes and Stekler, 2002, for a survey, and Döpke and Fritsche, 2006, for an overview of related papers for German data). While a large body of research has supported the hypothesis of rationality in German business cycle forecasts, some papers have recently challenged these findings. For example, Osterloh (2008) argues that forecasts with a horizon beyond one year do not fulfil the requirements for rational forecasts. A similar argument is made by Dovern and Weissner (2008), who base their argument on a methodological variation of tests for rationality using pooled data. Ager, Kappler and Osterloh (2009) not only reject the idea of information efficiency, but also find biased forecasts in some cases.

Virtually all of these studies, however, regardless of whether the point is made explicitly or implicitly, analyse the issue under the assumption of a symmetric loss function, *i.e.*, the notion that over- and underestimations are equally costly to the respective forecaster. While this assumption has been more or less undisputed for a long period, it may be criticised for very good economic reasons.

Consider possible customers of business cycle forecasters. For a single firm, for example, there is *a priori* no reason to assume that the costs of underpredicting demand in terms of a loss of sales or reputation should be exactly equal to the costs of overpredicting demand in terms of additional costs and storage (Elliot *et al.*, 2005, 2008). On a macroeconomic level, it is very likely that central banks have asymmetric preferences regarding inflation, perhaps leaning toward more caution against inflation acceleration. Alan Blinder summarises his experience as a central bank officer, claiming that a central bank "take(s) far more political heat if it tightens preemptively to avoid higher inflation than if it eases preemptively to avoid higher unemployment" (1998). Furthermore, while an overestimation of a budget deficit may help the career of a finance minister, an underestimation may end it. As the famous German economist and politician Ludwig Erhardt once put it: "If it gets better than expected, even the false prophet will be forgiven" (quoted according to Miersch, 2008). Furthermore, international or supranational institutions like the International Monetary Fund (IMF), World Bank or European Commission face principal-agent problems regarding their relationship with clients or member states – which, in turn, could justify asymmetric loss functions (Artis and Marcellino, 2001; Elliott *et al.*, 2005; Christodoulakis and Mamatzakis, 2008, 2009). An additional line of argument, which may point to the possibility of an asymmetric loss, refers to the political economy of business cycle forecasts (see Döpke, 2000, for related arguments). In this view, individual forecasters represent competing political points of view and use the forecasts as instruments to achieve their political goals. Hence, under- and overestimations of growth and inflation are likely to be unequally costly in the eyes of the forecaster, since they give different incentives for good or bad policies. Additional reasoning might be found in the model of Laster *et al.* (1999) who argue that forecasters face different incentives. For example, a private institution might be very interested in garnering public attention for its forecasts. All in all, a certain scepticism regarding the symmetry assumption is well justified. Therefore, we analyse signs of asymmetric loss functions for those institutions publishing regular forecasts for the German economy.

Consequently, several approaches have been developed to incorporate more general loss function into forecasting evaluations. Based on influential work by Chistofferson and Diebold (1997), Granger (1999) and Batchelor and Peel (1998), among others, Elliott *et al.* (2005, 2008) have proposed estimating the degree of asymmetry of the loss function and testing for a significant degree of asymmetry. Moreover, Patton and Timmerman (2007) analyse the properties of an optimal forecast under a generalised loss function and discuss how to test for these properties. We make use of these approaches to re-evaluate the issue of rationality of German business cycle forecasts, namely, growth and inflation forecasts covering the 1970-2007 time span, and up to 17 different forecasts.

In our results, we find only limited evidence of asymmetric loss functions of German business cycle forecasters. For example, for a piecewise linear (lin-lin) loss function, as in the approach of Patton and Timmerman (2007), we are not able to reject the null hypothesis of a symmetric loss function at the usual significance levels in all but two cases for each growth and inflation rate forecast. This conclusion, based on individual data, is further reinforced by evidence based on pooled data, where we also cannot reject the null hypothesis of an asymmetric lin-lin loss function at the usual significance levels, for both growth and inflation rate forecasts. In the case of the piecewise quadratic (quad-quad) loss function, the evidence against a symmetric loss function is stronger, as we can reject the corresponding null hypothesis for up to five institutions for each growth and inflation forecast, depending on a set of instrumental variables. Furthermore, in constrast to the results obtained on pooled data for the lin-lin loss function, in the case of a quad-quad loss function for growth forecasts we are able to reject the null hypothesis even at the 1% level for all considered sets of intruments, indicating a general tendency of forecasting institutions to produce overly optimistic forecasts of GDP growth rates. We also find some evidence of asymmetry in pooled inflation forecasts, but the test outcome appears not to be fully robust *vis-à-vis* the choice of instruments.

Furthermore, we check whether the usual results concerning the rationality of the forecasts still hold when the assumption regarding the loss function is relaxed. In a nutshell, we find that neither a specifically asymmetric loss function nor the assumption of a generalised loss function alters the findings obtained under a symmetric loss function by very much, although the results of the test proposed by Elliot *et al.* (2005) give some contrary results for inflation forecasts.

The remainder of the paper is organised as follows. Section 1 describes the data and the econometric method proposed by Elliot *et al.* (2005) to back out the parameter of asymmetry of a loss function and statistical testing for the existence of asymmetry, and discusses the results for the data set at hand. Section 2 tests for the rationality of the forecasts under different assumptions: a symmetric loss function, a specific asymmetric loss function and a generalised loss function. Section 3 summarises and concludes.

1. Estimating loss function asymmetry parameters and testing for asymmetry

We evaluate the forecasts of several institutions that deliver macroeconomic forecasts regarding the German economy. Further details on the data set can be found in Döpke and Fritsche (2006). For all institutions, we have collected growth and inflation forecasts. The growth forecast is the predicted growth rate of real GNP (for the time span 1983 to 1989) and of real GDP (for all other years). In the case of published interval forecasts, the average is used. The numbers refer to West Germany up to 1992, and to the whole of Germany from 1993 to the present. As a measure of the inflation forecast, we use the predicted change of the deflator of private consumption, when this figure is available. In some cases, however, no explicit reference was given to whether an inflation forecast referred to the consumption deflator or to the CPI/HICP. In such cases we assume that no distinction between the figures was intended by the forecaster, and we use the available inflation forecast. As regards the actual outcome, it is possible to refer to the latest available revised data or to the first published ("real-time") data. As it is common in the analysis of business cycle forecasts, we make use of the latter type of numbers, *i.e.,* we compare the forecasts made at the end of a certain year "x" or at the beginning of the following year "x + 1" with the first published figure for the year "x + 1".

The analysis by Elliot *et al.* (2005) starts from the general loss function:[1]

$$L(p,\alpha,\Theta) = \left[\alpha + (1-2\alpha)\cdot 1((y_{t+1}-\hat{y}_{t+1})\right]\cdot\left|y_{t+1}-\hat{y}_{t+1}\right|^{p} \tag{1}$$

In this loss function the parameter p represents the underlying assumption of the subsequent analysis. In particular, $p = 1$ stands for a linear-linear (lin-lin) loss function, while in case of $p = 2$ the calculations are based on a quadratic-quadratic (quad-quad) loss function. Furthermore, the loss function contains the parameter α representing the degree of asymmetry of the loss function. In particular, $\alpha = 0.5$ yields a symmetric loss function, while $\alpha > 0.5$ represents the case of forecasters' incentives to issue optimistic forecasts. Finally, $\alpha < 0.5$ stands for the case of forecasts that are too pessimistic. Thus, a particular set of parameters leads to a well-known loss function. For example, $L(2,1/2,\Theta) = (y_{t+1}-\hat{y}_{t+1})^2$ yields a symmetric quadratic loss function (Elliot *et al.*, 2005, p. 1110). The key problem they address is, of course, that the value of this parameter is unknown and has to be estimated from the data.

Elliot *et al.* (2005) establish conditions for optimality of forecasts, which, in turn, deliver the necessary moment conditions. By observing the sequence of forecasts, the authors propose a generalised method of moments (GMM) estimator that yields the following expression to estimate the asymmetry parameter of the loss function out of the moment conditions:

$$\hat{\alpha}_T = \frac{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau+1} v_t\left|y_{t+1}-\hat{y}_{t+1}\right|^{p_0-1}\right]'\hat{S}^{-1}\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau+1} v_t\mathbf{1}(y_{t+1}-\hat{y}_{t+1}<0)\left|y_{t+1}-\hat{y}_{t+1}\right|^{p_0-1}\right]}{\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau+1} v_t\left|y_{t+1}-\hat{y}_{t+1}\right|^{p_0-1}\right]'\hat{S}^{-1}\left[\frac{1}{T}\sum_{t=\tau}^{T+\tau+1} v_t\left|y_{t+1}-\hat{y}_{t+1}\right|^{p_0-1}\right]} \tag{2}$$

with $\hat{S} = \frac{1}{T}\upsilon\upsilon'(\mathbf{1}(y_{t+1}-\hat{y}_{t+1}<0)-\alpha_t)^2\left|y_{t+1}-\hat{y}_{t+1}\right|^{2p_0-2}$ as a weighting matrix. Since S depends on α_T, estimation has to be performed iteratively, assuming S = 1 in the first round, since the identity matrix is a consistent starting point, and using v_t as instrument(s). The estimation is based on considerations that have led to the GMM estimator proposed by Hansen (see Hansen and West, 2002, for a survey and a discussion of its relation to macroeconomic applications). Elliot *et al.* (2005) show that the estimator of α_T is asymptotically normal and, hence, renders it possible to test for the hypothesis $\alpha = 0.5$, *i.e.,* for loss function symmetry.

Instruments are warranted for the proposed GMM estimator. Following Elliot *et al.* (2005, p. 461), our instruments are: *i)* a constant; *ii)* a constant and a lagged forecast error; *iii)* a constant and the lagged variable to be predicted (*i.e.*, the growth and inflation rate, respectively); and *iv)* a constant, the lagged forecast error and the lagged variable to be predicted. We use the terms Model 1 to 4 in the course of the paper for estimations based on each of the four sets of instruments, respectively. These are the sets of instruments proposed in the literature and that also have been used in a similar context (Elliott *et al.*, 2005; Christodoulakis and Mamatzakis, 2008, 2009). The estimation results for the data set under investigation are given for lin-lin loss functions in Table 1 and quad-quad loss functions in Table 2.

As regards growth forecasts and calculations based on the assumption of a lin-lin loss function, the findings presented in Table 1 suggest only very limited evidence of

Table 1. **Evidence for an asymmetric loss function, lin-lin function**

	Model 1	s.e.	*p*-value	Model 2	s.e.	*p*-value	Model 3	s.e.	*p*-value	Model 4	s.e.	*p*-value
Growth forecasts												
Berlin Institute	0.320	0.077	0.022	0.319	0.077	0.018	0.320	0.077	0.019	0.318	0.077	0.017
Council of Economic Advisers	0.595	0.081	0.241	0.595	0.081	0.241	0.607	0.080	0.182	0.639	0.079	0.079
Employers Institute	0.571	0.084	0.393	0.575	0.084	0.372	0.578	0.083	0.352	0.578	0.083	0.351
Essen Institute	0.568	0.081	0.407	0.568	0.081	0.407	0.573	0.081	0.372	0.578	0.081	0.339
European Commission, autumn	0.541	0.082	0.621	0.542	0.082	0.611	0.547	0.082	0.569	0.550	0.082	0.545
European Commission, spring	0.486	0.082	0.869	0.486	0.082	0.869	0.486	0.082	0.869	0.486	0.082	0.869
Government's Economic Report	0.514	0.082	0.869	0.514	0.082	0.866	0.515	0.082	0.853	0.516	0.082	0.850
Halle Institute	0.571	0.132	0.589	0.572	0.132	0.588	0.576	0.132	0.567	0.586	0.132	0.515
Hamburg Institute	0.432	0.081	0.407	0.432	0.081	0.403	0.428	0.081	0.377	0.427	0.081	0.370
IMF, autumn	0.588	0.084	0.296	0.588	0.084	0.296	0.592	0.084	0.274	0.624	0.083	0.136
IMF, spring	0.444	0.083	0.502	0.441	0.083	0.475	0.444	0.083	0.501	0.441	0.083	0.472
Joint Forecast, spring	0.514	0.082	0.869	0.514	0.082	0.869	0.514	0.082	0.869	0.514	0.082	0.869
Joint Forecast, autumn	0.486	0.082	0.869	0.486	0.082	0.866	0.485	0.082	0.855	0.485	0.082	0.851
Kiel Institute	0.486	0.082	0.869	0.486	0.082	0.869	0.486	0.082	0.863	0.486	0.082	0.861
Munich Institute	0.459	0.082	0.621	0.459	0.082	0.620	0.459	0.082	0.618	0.459	0.082	0.618
OECD	0.568	0.081	0.407	0.571	0.081	0.383	0.581	0.081	0.318	0.585	0.081	0.294
Trade Union Institute	0.486	0.082	0.869	0.486	0.082	0.866	0.485	0.082	0.851	0.484	0.082	0.849
Pooled data	0.505	0.020	0.807	0.505	0.020	0.806	0.505	0.020	0.797	0.505	0.202	0.793
Inflation forecasts												
Berlin Institute	0.378	0.080	0.127	0.333	0.077	0.031	0.374	0.080	0.114	0.327	0.077	0.025
Council of Economic Advisers	0.649	0.078	0.058	0.704	0.075	0.007	0.705	0.075	0.006	0.714	0.074	0.004
Employers Institute	0.514	0.084	0.866	0.515	0.084	0.861	0.515	0.084	0.857	0.515	0.084	0.856
Essen Institute	0.514	0.082	0.869	0.533	0.082	0.688	0.525	0.082	0.763	0.535	0.082	0.671
European Commission, autumn	0.568	0.081	0.407	0.602	0.080	0.206	0.576	0.081	0.353	0.606	0.080	0.189
European Commission, spring	0.432	0.081	0.407	0.428	0.081	0.374	0.432	0.081	0.401	0.428	0.081	0.374
Government's Economic Report	0.432	0.081	0.407	0.416	0.081	0.297	0.430	0.081	0.390	0.414	0.081	0.291
Halle Institute												
Hamburg Institute	0.568	0.081	0.407	0.588	0.081	0.274	0.575	0.081	0.354	0.588	0.081	0.274
IMF, autumn	0.441	0.085	0.490	0.427	0.085	0.392	0.439	0.085	0.472	0.427	0.085	0.389
IMF, spring	0.528	0.083	0.738	0.531	0.083	0.711	0.528	0.083	0.735	0.531	0.083	0.711
Join Forecast, spring	0.405	0.081	0.241	0.388	0.080	0.160	0.390	0.080	0.169	0.382	0.080	0.139
Joint Forecast, autumn	0.649	0.078	0.058	0.702	0.075	0.007	0.670	0.077	0.028	0.710	0.075	0.005
Kiel Institute	0.432	0.081	0.407	0.412	0.081	0.276	0.432	0.081	0.401	0.392	0.080	0.178
Munich institute	0.541	0.082	0.621	0.546	0.082	0.578	0.543	0.082	0.596	0.546	0.082	0.575
OECD	0.600	0.089	0.264	0.622	0.089	0.169	0.600	0.089	0.261	0.630	0.088	0.141
Trade Union Institute	0.514	0.082	0.869	0.519	0.082	0.819	0.514	0.082	0.869	0.523	0.082	0.780
Pooled data	0.509	0.021	0.651	0.512	0.021	0.567	0.509	0.021	0.628	0.512	0.020	0.567

Legend: Model 1: Constant. Model 2: Constant and lagged forecast errors. Model 3: Constant and lagged variable. Model 4: Constant, lagged forecast error, lagged variable.

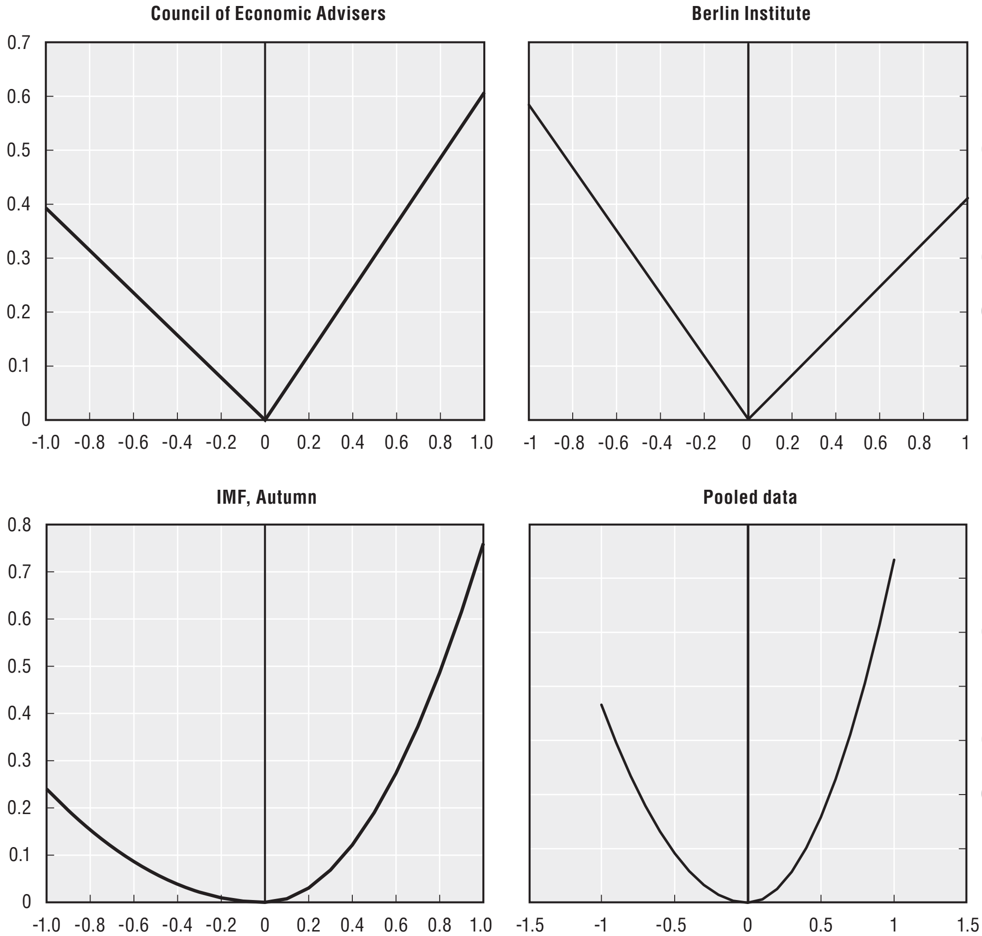
Table 2. **Evidence for an asymmetric loss function, quad-quad loss function**

	Model 1	s.e.	*p*-value	Model 2	s.e.	*p*-value	Model3	s.e.	*p*-value	Model 4	s.e.	*p*-value
Growth forecasts												
Berlin Institute	0.492	0.120	0.947	0.470	0.112	0.790	0.508	0.118	0.948	0.413	0.109	0.426
Council of Economic Advisers	0.647	0.104	0.159	0.645	0.103	0.157	0.674	0.100	0.080	0.686	0.099	0.060
Employers Institute	0.639	0.108	0.199	0.661	0.105	0.124	0.658	0.104	0.127	0.648	0.104	0.153
Essen Institute	0.611	0.099	0.265	0.599	0.097	0.309	0.622	0.098	0.212	0.604	0.097	0.287
European Commission, autumn	0.685	0.094	0.050	0.699	0.089	0.025	0.717	0.087	0.012	0.715	0.087	0.013
European Commission, spring	0.608	0.103	0.298	0.598	0.104	0.344	0.612	0.100	0.265	0.609	0.101	0.280
Government's Economic Report	0.614	0.106	0.279	0.616	0.105	0.270	0.628	0.103	0.214	0.614	0.102	0.263
Halle Institute	0.674	0.175	0.320	0.877	0.092	0.000	0.869	0.093	0.000	0.872	0.092	0.000
Hamburg Institute	0.592	0.108	0.392	0.597	0.107	0.366	0.606	0.106	0.318	0.608	0.106	0.309
IMF, autumn	0.745	0.085	0.004	0.748	0.084	0.003	0.760	0.082	0.001	0.881	0.058	0.000
IMF, spring	0.562	0.111	0.576	0.551	0.111	0.646	0.563	0.109	0.565	0.567	0.108	0.537
Join Forecast, spring	0.624	0.107	0.245	0.632	0.099	0.185	0.654	0.099	0.119	0.645	0.098	0.138
Joint Forecast, autumn	0.644	0.097	0.136	0.647	0.095	0.123	0.655	0.095	0.103	0.641	0.095	0.140
Kiel Institute	0.609	0.108	0.313	0.609	0.106	0.302	0.627	0.105	0.228	0.599	0.106	0.351
Munich institute	0.555	0.110	0.620	0.562	0.109	0.568	0.571	0.108	0.514	0.571	0.108	0.510
OECD	0.645	0.103	0.162	0.668	0.096	0.080	0.685	0.095	0.051	0.676	0.095	0.063
Trade Union Institute	0.534	0.109	0.752	0.538	0.108	0.727	0.545	0.107	0.673	0.544	0.108	0.684
Pooled data	0.617	0.025	0.000	0.620	0.025	0.000	0.626	0.026	0.000	0.634	0.025	0.000
Inflation forecasts												
Berlin Institute	0.383	0.103	0.259	0.352	0.102	0.146	0.372	0.103	0.214	0.351	0.102	0.140
Council of Economic Advisers	0.496	0.111	0.972	0.589	0.110	0.420	0.572	0.111	0.520	0.598	0.110	0.374
Employers Institute	0.568	0.121	0.575	0.567	0.121	0.582	0.603	0.118	0.384	0.602	0.116	0.380
Essen Institute	0.443	0.112	0.613	0.500	0.114	0.999	0.205	0.081	0.000	0.155	0.071	0.000
European Commission, autumn	0.474	0.112	0.814	0.627	0.109	0.244	0.575	0.112	0.504	0.633	0.108	0.220
European Commission, spring	0.544	0.105	0.675	0.601	0.098	0.303	0.557	0.102	0.576	0.602	0.098	0.296
Government's Economic Report	0.388	0.116	0.336	0.384	0.116	0.319	0.388	0.116	0.335	0.381	0.116	0.306
Hamburg Institute	0.501	0.119	0.993	0.679	0.108	0.098	0.624	0.113	0.274	0.677	0.107	0.099
IMF, autumn	0.626	0.106	0.234	0.649	0.104	0.151	0.644	0.104	0.163	0.634	0.104	0.198
IMF, spring	0.618	0.108	0.274	0.607	0.109	0.327	0.608	0.109	0.323	0.605	0.109	0.336
Joint Forecast, autumn	0.518	0.111	0.872	0.773	0.087	0.002	0.704	0.098	0.038	0.773	0.087	0.002
Joint Forecast, spring	0.444	0.107	0.605	0.448	0.107	0.629	0.470	0.105	0.775	0.462	0.104	0.713
Kiel Institute	0.414	0.119	0.473	0.070	0.060	0.000	0.235	0.094	0.005	0.078	0.061	0.000
Munich Institute	0.552	0.119	0.659	0.670	0.105	0.104	0.622	0.112	0.276	0.669	0.104	0.105
OECD	0.556	0.125	0.654	0.571	0.125	0.568	0.588	0.120	0.462	0.577	0.119	0.515
Trade Union Institute	0.509	0.112	0.938	0.681	0.098	0.065	0.546	0.110	0.676	0.698	0.097	0.040
Pooled data	0.497	0.029	0.926	0.574	0.028	0.009	0.543	0.029	0.137	0.578	0.028	0.006

Legend: Model 1: Constant. Model 2: Constant and lagged forecast errors. Model 3: Constant and lagged variable. Model 4: Constant, lagged forecast error, lagged variable.

asymmetric loss functions. Only in the case of the Berlin Institute do the individual results point to a loss function giving incentives for overly pessimistic forecasts. Depending on the number of instruments, there are also some weak (significant at the 10% level) results for a loss function of the Council of Economic Advisers fostering overly optimistic forecasts. The results may support conventional wisdom regarding these institutions: the Berlin Institute has long been seen as the most Keynesian of German institutes. Thus, being pessimistic might achieve a more activist economic policy. By contrast, the Council of Economic Advisers has widely been seen as supply-side oriented, and the opposite behaviour may be seen as plausible. The emerging general picture, however, is not completely in line with such an explanation, since other institutes with strong opinions (the Trade Union Institute or Employers Institute, for example) show no such results. The test results are illustrated by visual inspection of the estimated loss functions. Some pronounced cases of these functions are given in Figure 1. (The others are available upon request from the authors.)

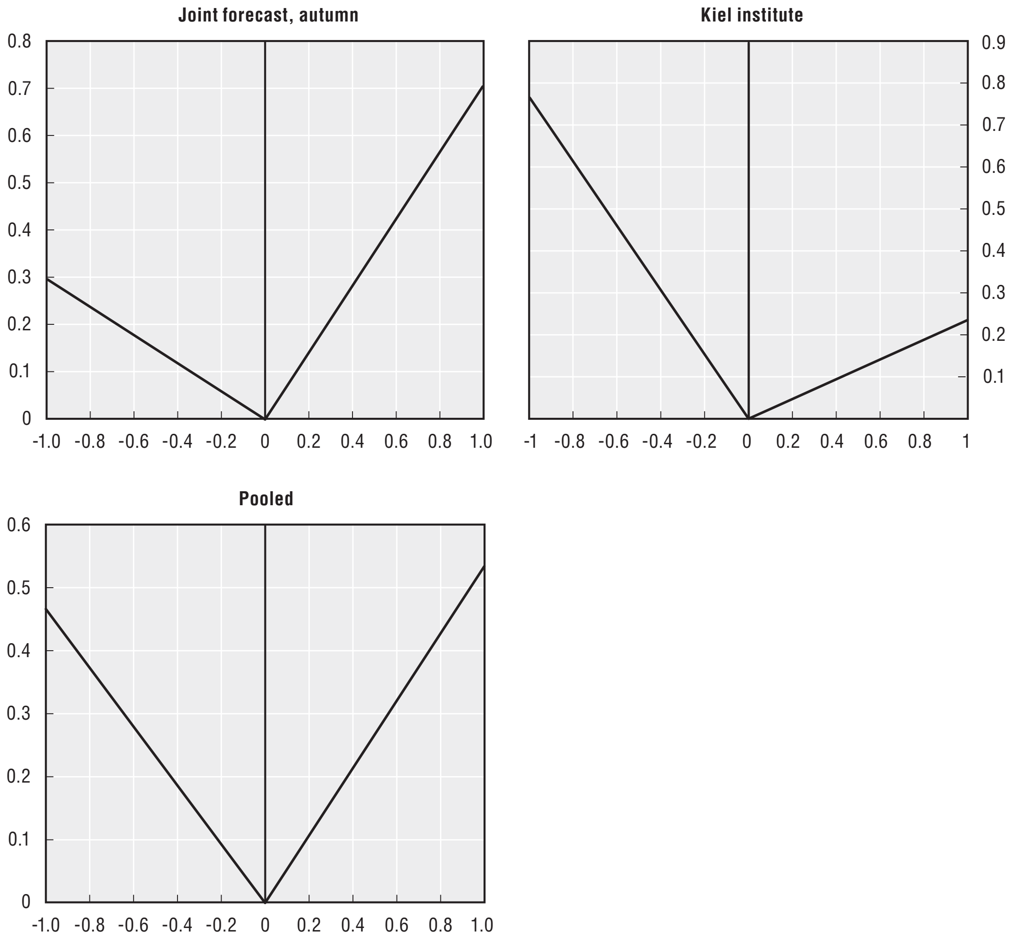
Figure 1. **Selected estimated loss functions, growth forecasts**



Most estimated loss functions look quite symmetric, representing the fact that virtually all estimated α parameters are very close to 0.5. This is also supported by the estimators based on pooled data – which could be interpreted as a joint test under no severe heterogeneity. For example, in Table 1 the pooled estimates of asymmetry parameter for a lin-lin function are close to 0.5 for both the growth and inflation forecasts, implying that, on average, all instituitions overpredict growth rates as often as they underpredict them.[2]

Turning to the inflation forecasts, there is slightly more hindsight to asymmetric loss functions under the lin-lin loss function. The Joint Forecast as well as the Council of Economic Advisers have overestimated inflation systematically in the past, while the Berlin Institute has more likely underestimated it. Again, visual inspection of the estimated loss functions (Figure 2) confirms the picture given by the formal statistical tests.

Figure 2. **Selected estimated loss functions, inflation forecasts**



Based on the assumption of a quad-quad loss function for growth forecasts, the broad picture remains more or less unchanged, *i.e.,* there is hardly any convincing evidence of a significant degree of asymmetry across the board of the forecasting institutions (see Table 2). Nevertheless, it is quite a remarkable fact that in all but one case the point estimate of the asymmetry parameter exceeds 0.5, indicating a general tendency of forecasting institutions to issue overly optimistic forecasts of GDP growth rates. As a reflection of this finding, the test based on pooled data decisively rejects the null hypothesis of a symmetric loss function. By pooling, we are able to estimate the parameter of interest with greater precision – that is, observe a substantial decrease in reported standard errors in pooled estimation compared to individual estimation results – and hence a significant gain in testing power is achieved, allowing us to reject the null hypothesis of $\alpha = 0.5$.[3]

As regards the inflation forecasts, we are able to reject the null hypothesis of symmetry more often under a quad-quad loss function than under a lin-lin loss function. Depending on a set of instrumental variables for up to five institutions – the Essen Institute, the Joint Forecast in autumn, the Kiel Institute, the Hamburg Institute and the Trade Unions Institute – the corresponding null hypothesis is rejected.

The overall impression is that the outcome of tests for loss function symmetry depends on a choice of the underlying loss function, such that under a quad-quad loss function we could reject the null hypothesis of symmetry more often than under a lin-lin loss function. This seems to happen for tests based on both individual and pooled data. This is unsurprising, as under different loss functions different features of forecast errors are taken into account. Thus, under the lin-lin loss function, only the proportion of negative forecast errors in total number of forecasts is relevant for estimation of the asymmetry parameter. At the same time, under the quad-quad loss function, a share of the sum of negative forecast errors in total sum of absolute values of forecast errors is taken into account. This implies that in a situation where a forecaster, on average, overestimates as often as underestimates a variable of interest, the asymmetry test based on the lin-lin loss function will not reject the null hypothesis. If, however, in this situation the size of negative forecast errors is on average larger than the size of positive forecast errors, the test based on the quad-quad loss function will reject the corresponding null hypothesis. It is interesting to observe that we find this pattern in our data set of forecast errors, implying that, on average, the number of overpredictions and underpredictions is balanced, but when overpredictions happen they tend to be of a larger magnitude.

2. Testing for rationality and optimality of a forecast under different loss functions

2.1. Testing for rationality under a symmetric loss function

Testing the rationality of a forecast under a symmetric loss function is typically based on two requirements. First, the forecast should be unbiased, *i.e.*, no systematic errors should occur (the expected value of the forecast error should not be different from zero). Second, the forecast should make efficient use of all information available at the forecasting date, *i.e.*, for an optimal forecast one should be unable to find any variables, which helps to forecast the errors. In a nutshell, former studies of the rationality of German business cycle forecasts have typically found them unbiased, but not necessarily efficient.

To obtain a first insight into the rationality of the forecasts under investigation, we present rationality tests based on a version of the Mincer-Zarnowitz equation (Batchelor and Peel, 1998). In particular, a standard rationality test can be based on estimating the equation

$$(y_{t+n} - \hat{y}_{t+n,t}) = \alpha_0 + \alpha_1(y_{t+n-1} - \hat{y}_t) + u_{t+n} \qquad (3)$$

As Batchelor and Peel (1998) (referring to Christofferson and Diebold, 1997) argue, under the null hypothesis of rationality, and assuming a symmetric loss function, forecast errors should be orthogonal to all information known at t, and in particular to the expected change in y. Thus, if the forecast is rational, $a_0 = 0$, $a_1 = 0$ holds. This is tested with a standard F-test. The results of this task are given in Table 3.

The results for growth forecasts, documented in Table 3, give few hints of departures from rationality. In fact, in all but one case (IMF, autumn) we cannot reject the corresponding null hypothesis of forecast rationality. This is also confirmed by the estimation and testing based on pooled data. Turning to inflation forecasts, rationality can be rejected at the usual significance levels in 10 out of 17 cases. Moreover, the null hypothesis is also rejected strongly in the case of pooled data. This is in line with the results reported in Döpke and Fritsche (2006) and possibly due to a high degree of serial correlation in the forecast errors, especially in the 1970s and 1980s. In general, we find very limited evidence for non-rationality under symmetric loss for growth forecasts, and overwhelming evidence for non-rationality for inflation forecasts.

Table 3. **Test for rationality of the forecasts under a symmetric loss function, 1970 to 2007**

	Constant	Slope	Test for rationality (*F*-value)	Test for rationality (*p*-value)
Growth forecasts				
Berlin Institute	0.015 (0.06)	0.081 (0.48)	0.118	0.89
Council of Economic Advisors	–0.293 (–1.20)	0.031 (0.18)	0.825	0.45
Employers Institute[1]	–0.398 (–1.41)	–0.247 (–1.47)	1.758	0.19
Essen Institute	–0.199 (–0.89)	0.107 (0.62)	0.727	0.49
European Commission, autumn	–0.456 (–1.64)	–0.027 (–0.16)	1.388	0.26
European Commission, spring	–0.140 (–0.77)	0.142 (0.86)	0.808	0.46
Government's Economic Report	–0.253 (–1.09)	–0.142 (–0.84)	0.818	0.45
Halle Institute[2]	–0.332 (–1.35)	–0.352 (–1.37)	1.397	0.28
Hamburg Institute	–0.190 (–0.83)	–0.075 (–0.45)	0.408	0.67
IMF, autumn[3]	–0.660 (–2.08)	0.007 (0.04)	2.55	0.09
IMF, spring[4]	–0.067 (–0.34)	0.295 (1.79)	1.756	0.19
Joint Forecast, autumn	–0.349 (–1.27)	–0.009 (–0.05)	0.829	0.45
Joint Forecast, spring	–0.202 (–1.04)	–0.005 (–0.03)	0.594	0.58
Kiel Institute	–0.221 (–0.87)	0.027 (0.16)	0.416	0.66
Munich Institute	–0.116 (–0.53)	–0.127 (0.76)	0.399	0.67
OECD	–0.345 (–1.32)	–0.082 (–0.49)	0.895	0.42
Trade Union Institute	–0.086 (–0.33)	–0.055 (–0.32)	0.098	0.91
Pooled data	–0.051 (–1.18)	–0.062 (–1.47)	1.780	0.17
Inflation forecasts				
Berlin Institute	0.096 (0.67)	0.356 (2.31)	3.296	0.049
Council of Economic Advisors	–0.012 (–0.86)	0.459 (3.12)	4.874	0.01
Employers Institute[1]	–0.061 (–0.50)	0.196 (1.20)	0.865	0.43
Essen Institute	0.012 (0.10)	0.536 (3.86)	7.617	0.002
European Commission, autumn	0.001 (0.01)	0.547 (4.00)	8.030	0.001
European Commission, spring	–0.022 (–0.28)	0.259 (1.56)	1.302	0.28
Government's Economic Report	0.073 (0.53)	0.376 (2.45)	3.459	0.04
Halle Institute[2]	0.046 (0.23)	0.219 (0.76)	0.321	0.73
Hamburg Institute	–0.016 (–0.11)	0.458 (3.12)	4.875	0.014

Table 3. **Test for rationality of the forecasts under a symmetric loss function, 1970 to 2007** *(cont.)*

	Constant	Slope	Test for rationality (*F*-value)	Test for rationality (*p*-value)
IMF, autumn[3]	–0.127 (–0.89)	0.289 (1.86)	2.344	0.11
IMF, spring[4]	–0.068 (–0.52)	0.413 (2.66)	4.11	0.025
Joint Forecast, autumn	–0.038 (–0.27)	0.563 (4.23)	8.973	0.001
Joint Forecast, spring	0.042 (0.43)	0.221 (1.33)	1.011	0.374
Kiel Institute	0.015 (0.10)	0.581 (4.67)	11.278	0.0001
Munich Institute	–0.054 (–0.39)	0.231 (1.44)	1.134	0.33
OECD	–0.041 (–0.30)	0.194 (1.08)	0.656	0.524
Trade Union Institute	–0.014 (–0.09)	0.547 (3.92)	7.96	0.002
Pooled data	–0.106 (–3.18)	–0.302 (–7.12)	37.78	0.000

1. 1972 to 2007.
2. 1993 to 2007.
3. 1973 to 2007.
4. 1971 to 2007 (t-values in parentheses).

2.2. Rationality testing under an asymmetric loss function

2.2.1. The Batchelor/Peel (1998) approach

One approach to test for forecast rationality under an asymmetric loss function has been proposed by Batchelor and Peel (1998). They start from a so-called linex loss function, which takes the form:

$$L = \frac{\beta}{\delta^2}\left[\exp(\delta e_t - \delta e_t - 1\right],$$

where δ and β are constants and e is the forecast error as described above. The parameter δ determines the degree of asymmetry, while β is a scaling factor. For $\delta > 0$, losses are approximately exponential for $e > 0$ and approximately linear for $e < 0$. If the forecast error is defined as in our case, this presents a situation where underestimations are more costly than overestimations. Conversely, with $\delta < 0$ the function is exponential to the left of the origin of e, and linear to the right. Asymptotically for $\delta = 0$, the function coincides with the standard quadratic case.

The standard rationality test may be extended as follows: Bachelor and Peel (1998) argue that under the linex loss function the optimal forecast has a clearly defined bias. This bias, in turn, depends on the volatility of the time series to be forecasted and has an analytical expression for the linex loss function. Thus, to test for rationality, an additional term in the test equation is warranted which reflects the expected value of the conditional error variance:

$$(y_{t+1} - \hat{y}_{t+1,t}) = \alpha_0 + \alpha_1(\hat{y}_{t+1,t} - y_t) + \frac{\delta}{2}E_t(\sigma^2_{t+1}) + u_t \tag{4}$$

Again, the null of a rational forecast is represented by the parameter restriction $a_0 = 0$, $a_1 = 0$. Thus, in empirical testing, Batchelor and Peel (1998) suggest estimating an

ARCH-in-Mean model, from Engle, Lilian and Roberts (1987). In their original paper, they suggest a GARCH(1,1) model, but argue that the test for rationality does not depend on a specific form of the ARCH-in-Mean term. Hence, in our case, we start with the presumably most simple GARCH(1,1) and use other models only in cases where this model does not fit well with the data. It turns out that, in most cases, using the log for the ARCH-in-Mean term helps to achieve convergence. All in all, the test is performed by estimating the following equations:

$$
\begin{aligned}
&(y_{t+1} - \hat{y}_{t+1,t}) = \alpha_0 + \alpha_1(\hat{y}_{t+1,t} - y_t) + \alpha_2 E_t(\sigma^2_{t+1}) + u_{t+1} \\
&u_t \sim N(0, \sigma^2_{t+1}) \qquad (5) \\
&\sigma^2_{t+1} = c_1 + c_2 u^2_{t+1} + c_3 \sigma^2_t
\end{aligned}
$$

As in the original contribution of Batchelor and Peel (1998), the ARCH-in-Mean terms turn out to be insignificant in most of cases here. The presence of this term might, however, alter the estimates of the other coefficients in the equation and, thus, the results of testing for rationality, namely, $a_0 = 0$, $a_1 = 0$. The results presented in Table 4 suggest that in all but one cases (the Council of Economic Advisers), the null of rationality cannot be rejected for the growth forecasts considered in this paper. The results change when considering the inflation forecast errors; in this case, at least four institutions produced forecasts that could be interpreted as non-rational – even under asymmetric loss. Compared to the results for a symmetric loss reported in Table 3 – where ten institutions could be labeled as those departing from rationality assumption – we observe a remarkable drop in the number of non-rational forecasts. This finding emphasizes the importance of allowing for asymmetric loss function of forecasters when testing for forecast rationality.

Table 4. **Test for rationality of the forecasts under an asymmetric loss function (Batchelor/Peel approach), 1970 to 2007**

		Constant	Slope	Test for rationality (*F*-value)	Test for rationality (*p*-value)
Growth forecasts					
Berlin Institute	Coefficient	0.08	0.40	1.47	0.24
	t-value	0.14	2.02		
Council of Economic Advisors	Coefficient	2.11	–0.33	5.22	0.01
	t-value	0.52	–1.65		
Employers Institute[1]	Coefficient	–0.47	–0.10	0.04	0.96
	t-value	–1.23	–0.41		
Essen Institute	Coefficient	–0.61	–0.14	0.55	0.58
	t-value	–2.70	–0.47		
European Commission, autumn	Coefficient	–0.03	–0.14	0.92	0.41
	t-value	–0.12	–0.62		
European Commission, spring[2]	Coefficient	–0.37	0.42	0.59	0.56
	t-value	–1.38	2.12		
Government's Economic Report	Coefficient	–0.23	0.06	0.02	0.98
	t-value	–0.56	0.27		
Halle Institute[3]	Coefficient	0.02	–0.39	1.45	0.29
	t-value	0.16	–1.11		
Hamburg Institute	Coefficient	–0.70	–0.21	0.36	0.70
	t-value	–1.15	–0.71		
IMF, autumn[4]	Coefficient	–1.15	–0.04	1.38	0.27
	t-value	–1.69	–0.08		
IMF, spring[5]	Coefficient	0.06	0.16	1.38	0.27
	t-value	0.27	0.55		

Table 4. **Test for rationality of the forecasts under an asymmetric loss function (Batchelor/Peel approach), 1970 to 2007** *(cont.)*

		Constant	Slope	Test for rationality (*F*-value)	Test for rationality (*p*-value)
Joint Forecast, autumn	Coefficient	1.44	–0.46	0.37	0.69
	t-value	0.50	–0.48		
Joint Forecast, spring	Coefficient	1.44	–0.46	0.37	0.69
	t-value	0.50	–0.48		
Kiel Institute	Coefficient	–2.19	0.20	1.22	0.31
	t-value	–0.36	0.36		
Munich Institute	Coefficient	–0.42	0.03	0.24	0.78
	t-value	–0.44	0.25		
OECD	Coefficient	–0.64	–0.30	0.03	0.97
	t-value	–1.46	–1.53		
Trade Union Institute	Coefficient	0.15	0.04	1.68	0.20
	t-value	0.91	0.16		
Inflation forecasts					
Berlin Institute	Coefficient	0.08	0.40	8.66	0.00
	t-value	0.14	2.02		
Council of Economic Advisors	Coefficient	2.11	–0.33	1.15	0.33
	t-value	0.52	–1.65		
Employers Institute[2]	Coefficient	–0.47	–0.10	2.31	0.12
	t-value	–1.23	–0.41		
Essen Institute	Coefficient	–0.61	–0.14	0.53	0.60
	t-value	–2.70	–0.47		
European Commission, autumn	Coefficient	–0.03	–0.14	1.65	0.21
	t-value	–0.12	–0.62		
European Commission, spring	Coefficient	–0.10	0.08	0.79	0.46
	t-value	–0.50	0.43		
Government's Economic Report	Coefficient	–0.23	0.06	0.21	0.81
	t-value	–0.56	0.27		
Halle Institute[3]	Coefficient	Convergence failed			
Hamburg Institute	Coefficient	–0.70	–0.21	0.27	0.76
	t-value	–1.15	–0.71		
IMF, autumn[1]	Coefficient	–1.15	–0.04	2.28	0.12
	t-value	–1.69	–0.08		
IMF, spring[4]	Coefficient	0.06	0.16	2.28	0.12
	t-value	0.27	0.55		
Joint Forecast, autumn	Coefficient	1.44	–0.46	11.30	0.00
	t-value	0.50	–0.48		
Joint Forecast, spring	Coefficient	1.44	–0.46	0.56	0.57
	t-value	0.50	–0.48		
Kiel Institute	Coefficient	–2.19	0.20	11.66	0.00
	t-value	–0.36	0.36		
Munich Institute	Coefficient	–0.42	0.03	0.58	0.57
	t-value	–0.44	0.25		
OECD	Coefficient	–0.96	–0.19	0.69	0.51
	t-value	–1.03	–0.46		
Trade Union Institute	Coefficient	0.15	0.04	2.67	0.08
	t-value	0.91	0.16		

1. 1972 to 2007.
2. 1993 to 2007.
3. 1973 to 2007.
4. 1971 to 2007.
5. Convergence could be achieved only after eliminating the outlier in year 1975 by a dummy variable in the mean equation.

2.2.2. *The Elliot* et al. *(2005) approach*

Elliot *et al.* (2005) suggest a test of the joint null hypothesis of forecast rationality and the more flexible loss function. Under the null hypothesis, the test statistic is:

$$J = \frac{1}{T}\left(\sum_{t=\tau}^{T+\tau+1}\left[v_t \mathbf{1}\left(y_{t+1}-\hat{y}_{t+1}-\alpha_T\right)\right]\left|y_{t+1}-\hat{y}_{t+1}\right|^{p_0-1}\right)' \hat{S}^{-1}\left(\sum_{t=\tau}^{T+\tau+1}\left[v_t \mathbf{1}\left(y_{t+1}-\hat{y}_{t+1}-\alpha_T\right)\right]\left|y_{t+1}-\hat{y}_{t+1}\right|^{p_0-1}\right)' \sim X^2_{d-1} \quad (6)$$

Hence, a rejection of the null hypothesis might be due to irrationality of the forecast or to the rejection of the functional form of the loss function (1). The results for our data at hand are given in Table 5.

Table 5. **Joint test for forecast rationality and loss function (*J*-test), lin-lin function, 1970 to 2007**

	J-test (Model 2)	*p*-value	*J*-test (Model 3)	*p*-value	*J*-test (Model 4)	*p*-value
Growth forecasts						
Berlin Institute	0.57	0.45	0.49	0.48	0.69	0.71
Council of Economic Advisers	0.01	0.98	2.18	0.14	5.90	0.05
Employers Institute	0.76	0.39	1.42	0.23	1.44	0.49
Essen Institute	0.00	0.98	1.27	0.26	2.39	0.30
European Commission, autumn	0.51	0.48	2.42	0.12	3.35	0.19
European Commission, spring	0.05	0.83	0.00	0.95	0.08	0.96
Government's Economic Report	0.48	0.49	2.11	0.15	2.45	0.29
Halle Institute	0.01	0.91	0.39	0.53	1.16	0.56
Hamburg Institute	0.13	0.72	1.11	0.29	1.36	0.51
IMF, autumn	0.00	0.98	0.72	0.40	4.89	0.09
IMF, spring	1.08	0.30	0.04	0.84	1.19	0.55
Joint Forecast, autumn	0.45	0.50	1.89	0.17	2.25	0.33
Joint Forecast, spring	0.02	0.89	0.04	0.85	0.04	0.98
Kiel Institute	0.04	0.84	0.90	0.34	1.19	0.55
Munich Institute	0.03	0.88	0.12	0.73	0.13	0.94
OECD	0.90	0.34	3.07	0.08	3.80	0.15
Trade Union Institute	0.43	0.51	2.26	0.13	2.50	0.29
Pooled data	0.99	0.32	14.38	0.00	19.53	0.00
Inflation forecasts						
Berlin Institute	5.02	0.03	0.61	0.44	5.52	0.06
Council of Economic Advisers	4.99	0.03	5.06	0.02	5.62	0.06
Employer's Institute	0.57	0.45	1.12	0.29	1.14	0.56
Essen Institute	10.90	0.00	8.39	0.00	11.32	0.00
European Commission, autumn	6.21	0.01	1.94	0.16	6.66	0.04
European Commission, spring	1.21	0.27	0.20	0.65	1.21	0.55
Government's Economic Report	3.69	0.06	0.65	0.42	3.88	0.14
Hamburg Institute	4.37	0.04	1.91	0.17	4.37	0.11
IMF, autumn	3.22	0.07	0.65	0.42	3.32	0.19
IMF, spring	1.75	0.19	0.24	0.62	1.77	0.41
Joint Forecast, autumn	4.88	0.03	2.31	0.13	5.43	0.07
Joint Forecast, spring	2.93	0.09	2.63	0.11	3.70	0.16
Kiel Institute	4.33	0.04	0.23	0.63	6.94	0.03
Munich Institute	2.03	0.16	1.20	0.27	2.18	0.34
OECD	2.69	0.10	0.07	0.79	3.44	0.18
Trade Union Institute	5.23	0.02	0.03	0.86	7.59	0.02
Pooled data	62.23	0.00	19.85	0.00	62.42	0.00

Table 5. **Joint test for forecast rationality and loss function (*J*-test), lin-lin function, 1970 to 2007** *(cont.)*

	J-test (Model 2)	*p*-value	*J*-test (Model 3)	*p*-value	*J*-test (Model 4)	*p*-value
Growth forecasts						
Berlin Institute	0.20	0.66	0.97	0.32	2.48	0.29
Council of Economic Advisers	0.01	0.93	0.94	0.33	2.43	0.30
Employers Institute	1.62	0.20	0.60	0.44	1.96	0.38
Essen Institute	0.28	0.60	0.58	0.45	1.81	0.40
European Commission, autumn	0.22	0.64	0.98	0.32	1.40	0.50
European Commission, spring	0.93	0.33	0.04	0.85	1.12	0.57
Government's Economic Report	0.91	0.34	0.49	0.48	0.92	0.63
Halle Institute	1.49	0.22	1.39	0.24	1.58	0.45
Hamburg Institute	0.24	0.63	0.67	0.41	0.74	0.69
IMF, autumn	0.07	0.79	0.65	0.42	5.59	0.06
IMF, spring	2.59	0.11	0.00	0.97	2.89	0.24
Joint Forecast, autumn	0.03	0.87	0.81	0.37	2.17	0.34
Joint Forecast, spring	0.04	0.83	0.70	0.40	0.89	0.64
Kiel Institute	0.00	0.99	1.39	0.24	3.72	0.16
Munich Institute	0.49	0.49	0.67	0.42	0.81	0.67
OECD	0.43	0.51	1.35	0.24	2.07	0.36
Trade Union Institute	0.09	0.77	0.82	0.37	2.08	0.35
Pooled data	0.40	0.53	11.33	0.00	20.42	0.00
Inflation forecasts						
Berlin Institute	5.02	0.03	2.79	0.09	5.04	0.08
Council of Economic Advisers	5.68	0.02	6.62	0.01	6.39	0.04
Employers Institute	1.33	0.25	2.02	0.16	2.02	0.36
Essen Institute	6.82	0.00	4.11	0.04	11.32	0.00
European Commission, autumn	6.39	0.01	5.52	0.02	6.38	0.04
European Commission, spring	2.16	0.14	0.24	0.62	2.28	0.24
Government's Economic Report	3.46	0.06	0.77	0.38	4.67	0.09
Hamburg Institute	5.11	0.02	4.23	0.04	5.14	0.07
IMF, autumn	2.96	0.08	1.06	0.30	3.38	0.21
IMF, spring	2.66	0.10	2.98	0.08	3.15	0.21
Joint Forecast, autumn	6.21	0.01	5.50	0.02	6.21	0.04
Joint Forecast, spring	1.35	0.24	1.27	0.26	1.57	0.46
Kiel Institute	8.70	0.00	6.37	0.01	10.37	0.01
Munich Institute	3.21	0.07	2.19	0.13	3.22	0.20
OECD	0.92	0.33	0.59	0.44	0.92	0.63
Trade Union Institute	5.29	0.02	1.89	0.17	6.25	0.04
Pooled data	60.84	0.00	47.98	0.00	61.94	0.00

Legend: Model 2: Constant and lagged forecast errors. Model 3: Constant and lagged variable. Model 4: Constant, lagged forecast error, lagged variable.

In the case of growth forecasts and the lin-lin setting, the null hypothesis has to be rejected in only very few cases. In particular, for the IMF autumn forecast, the OECD and the Council of Economic Advisers, the composite null hypothesis is not supported by the data. In none of the three cases, however, does the result appear to be robust with respect to the choice of the instruments. Thus, these suggestions of either irrationality of the forecasts or the necessity of a different loss function are not convincing. By contrast, the results for the inflation forecasts lead to a rejection of the null hypothesis for virtually any of the institutions under investigation. Given the point estimates of the asymmetry parameter reported in Section 2, one might suspect that the rejection is due to the failure of the rationality hypothesis rather than the assumption of a particular loss function, but formally the test does not tell anything about this. However, the results reported for similar tests based on the assumption of a quad-quad loss function yield a similar picture: again, there are very few results, if any at all, pointing to the rejection of the null for the growth forecasts, but the inflation forecasts fail to achieve rationality under this particular loss function. Hence, the rationality of growth forecasts is generally supported by the *J*-test while the rationality of the inflation forecasts is much more in doubt. It is noteworthy that the null of rationality of inflation forecasts is more frequently rejected when the lagged forecast errors are used as instruments (*i.e.*, Models 2 and 4), implying that the orthogonality condition between actual and lagged forecast errors does not hold. This finding corresponds to the high positive autocorrelation of the inflation forecast errors frequently reported in the literature (see Döpke and Fritsche, 2006, and the papers cited therein).

Turning to the results based on pooled data, we find that growth forecast errors appear to be orthogonal to own past forecast errors (Model 2), for both pooled and individual forecasts. Furthermore, the pooled estimates provide decisive evidence against the forecast rationality when we include lagged GDP in the IV set, contradicting the results based on individual GMM estimations.

In the case of inflation, we have decisive rejection of forecast rationality for all IV sets, corroborating most evidence from individual GMM. Observe that the magnitude of pooled *J*-test statistics for inflation by far exceeds that of growth forecasts, which is also in line with the stronger evidence against forecast rationality observed from individual *J*-tests.

3. Conclusion

The paper analyses the degree of asymmetry of German business cycle forecasts, namely, growth and inflation forecasts covering the 1970-2007 period and up to 17 different forecasting institutions. We find the forecasts to be mostly symmetric, with only few exceptions. The point estimates of the degree of asymmetry are not systematic in any respect: some forecasters seem to have incentives for overly pessimistic forecasts, others for overly optimistic forecasts. There is a general tendency for inflation forecasts to be biased. The results appear to be not fully robust against the choice of the instruments warranted to estimate the loss function with a GMM approach. We also investigate the rationality of the forecasts at hand. To this end, we rely on the assumption of a symmetric loss function, but also make use of approaches based on an asymmetric or even flexible loss function. In a nutshell, we find that neither a specifically asymmetric loss function nor the assumption of a generalised loss function alters, by any significant amount, the findings for growth forecasts obtained under a symmetric loss function. However, the results of the test proposed by Elliot *et al.* (2005) obtain contrary results for inflation forecasts – which indicates that it matters under which loss functions we test. We can detect decisively an asymmetric loss function in case of GDP forecasts (tendency to produce overly optimistic forecasts) only for a quad-quad loss function. Hence, using a different metric in forecast assessment leads to different conclusions.

As regards the question of forecast (ir-)rationality, we find virtually no hint of irrationality of growth forecasts as long as we refer to single institutions. By pooling the data, however, we obtain the opposite conclusion, *i.e.*, growth forecasts appear to be irrational as long as lagged GDP growth is included in the set of instruments. For inflation forecasts, the conclusions based on individual *J*-tests mostly agree with those obtained by pooling the data. Our results extend, therefore, previous research, which found growth forecasts to be inefficient in the case of a more general assumption regarding the underlying loss function and of inflation forecasts (see, *e.g.,* Dovern and Weissner, 2008; Osterloh, 2008; and Ager *et al*., 2009).

Given the results of this paper, some further research may be required. First, it should be verified whether data with a higher frequency may alter results. Having more data may help estimate the asymmetry parameter with greater precision and, hence, lead to more cases of a significant degree of asymmetry. Second, it may be worthwhile to estimate the asymmetry parameter for government in order to compare it with the values for the forecasters. It is plausible to assume that political entities have different loss functions from forecasters which may, in turn, explain some of the negative reputation of business cycle forecasts in public opinion.

Notes

1. Realisations are denoted by y and forecasts by $\hat{y}$.
2. For Model 1 there exists a closed-form solution to equation (2), implying that under the lin-lin function the estimate of the asymmetry parameter equals the share of negative forecast errors.
3. In case of the quad-quad loss function, the share of sum of negative forecast errors in total sum of both positive and negative forecast errors is relevant. For example, in the case of growth forecasts, we have a sum of negative forecast errors of –379.85 and a sum of positive forecasts errors of 235.80, which gives 379.85/(379.85 + 235.80) = 0.617 in the case of Model 1. The respective numbers for the inflation forecasts are –179.50 (sum of negative forecast errors) and 181.45 (sum of positive forecast errors), which leads to 179.5/(179.5 + 181.45) = 0.497 for Model 1.

References

Artis, M. and M. Marcellino (2001), “Fiscal Forecasting: The Track Record of the IMF”, OECD and EC, *Econometrics Journal*, No. 4, pp. 20-36.

Ager, P., M. Kappler and S. Osterloh (2009), “The Accuracy and Efficiency of the Consensus Forecasts: A Further Application and Extension of the Pooled Approach”, *International Journal of Forecasting*, No. 25, pp. 167-181.

Batchelor, R. and D. Peel (1998), “Rationality Testing under Asymmetric Loss”, *Economics Letters*, No. 61, pp. 49-54.

Blinder, A.S. (1998), “Central Banking in Theory and Practice”, Cambridge, MIT Press.

Christodoulakis, G. and M. Mamatzakis (2008), “An Assessment of the EU Growth Forecasts under Asymmetric Preferences”, *Journal of Forecasting*, No. 27, pp. 483-492.

Christodoulakis, G. and M. Mamatzakis (2009), “Assessing the Prudence of Economic Forecasts in the EU”, *Journal of Applied Econometrics*, No. 24, pp. 583-606.

Christoffersen, P.F. and F.X. Diebold (1997), “Optimal Prediction under Asymmetric Loss”, *Econometric Theory*, No. 13, pp. 808-817.

Dovern, J. and J. Weisser (2008), “Are They Really Rational? Assessing Professional Macro-Economic Forecasts from the G7-Countries”, *Kiel Working Papers*, No. 1447, Kiel Institute for the World Economy, Kiel.

Döpke, J. (2000), “Haben Konjunkturprognosen einen politischen Bias?”, *Schmollers Jahrbuch – Zeits-chrift für Wirtschafts- und Sozialwissenschaften*, No. 120, pp. 587-620.

Döpke, J. and U. Fritsche (2006), “Growth and Inflation Forecasts in Germany: A Panel-based Assessment of Accuracy and Dispersion”, *Empirical Economics*, No. 31, pp. 777-798.

Elliot, G., I. Komunjer and A. Timmermann (2005), “Estimation and Testing of Forecast Rationality under Flexible Loss”, *Review of Economic Studies*, No. 72, pp. 1107-1125.

Elliot, G., I. Komunjer and A. Timmermann (2008), “Biases in Macroeconomic Forecasts: Irrationality or Asymmetric Loss?”, *Journal of European Economic Association*, No. 6, pp. 122-15.

Engle, R.F., D.M. Lilien and R.P. Robins (1987), "Estimating Time-varying Premia in the Term Structure: The ARCH-M Model", *Econometrica*, No. 55, pp. 391-407.

Engle, R.F. (1982), "Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of UK Inflation", *Econometrica*, No. 50, pp. 987-1008.

Fildes, R. and H.O. Stekler (2002), "The State of Macroeconomic Forecasting", *Journal of Macroeconomics*, No. 24, pp. 435-468.

Granger, C.W.J. (1999), "Outline of Forecast Theory Using Generalized Cost Functions", *Spanish Economic Review*, No. 1, pp. 161-173.

Hansen, B.E. and K.D. West (2002), "Generalized Methods of Moments and Macroeconomics", *Journal of Business and Economics Statistics*, No. 20, pp. 460-490.

Laster, D., P. Bennet and I.S. Geoum (1999), "Rational Bias in Macroeconomic Forecasts", *Quarterly Journal of Economics*, No. 114, pp. 293-318.

Miersch, M. (2008). "Wir prognostizieren uns zu Tode", *http://debatte.welt.de/kommentare/103709/wir+prognostizieren+uns+zu+tode*.

Osterloh, S. (2008), "Accuracy and Properties of German Business Cycle Forecasts", *Applied Economics Quarterly*, No. 54, pp. 27-57.

Patton, A.J. and A. Timmermann (2007), "Testing Forecast Optimality under Unknown Loss", *Journal of American Statistical Association*, No. 102, pp. 1172-1184.