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Evaluating German Business Cycle Forecasts

Under an Asymmetric Loss Function

by

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Abstract

Based on annual data for growth and inflation forecasts for Germany covering the time span from 1970 to 2007 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 generalized loss function. We find evidence for the existence of an asymmetric loss function of German forecasters only in case of pooled data and a quad-quad loss function. We cannot reject the hypothesis of rationality of the growth forecasts based on data for single institutions, but based on a pooled data set. The rationality of inflation forecasts frequently is rejected in case of single institutions and also for pooled data.

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

JEL-Classification: C53, E42

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1. Introduction

The assumption that economic agents behave rationally when they form their expectations is a central assumption in economics and finance. 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 for German business cycle forecasts, some paper 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) do not only reject the idea of information efficiency, but 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 example, for a single firm, 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 cost and storage (Elliot et al., 2005, 2008). On a macroeconomic level, it is very likely that e.g. central banks have asymmetric preferences regarding inflation, perhaps in the direction of 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 it tightens preemptively to avoid higher inflation than it eases preemptively to avoid higher unemployment" (Blinder, 1998). Furthermore, while an overestimation of a budget deficit may foster the career of a finance minister, an underestimation may end it. Or, 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, e.g., Miersch, 2008). Furthermore, international or supranational institutions like IMF, World Bank, or the European Commission face agency problems regarding their relationships 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 argumentation, which may point to the possibility of an asymmetric loss, goes back 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. Furthermore, an 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 strongly interested in public attention for its forecasts. All in all, a certain scepticism regarding the symmetry assumption is therefore well justified. We will therefore analyse signs for 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 to estimate the degree of asymmetry of the loss function and to test for a significant degree of asymmetry. Moreover, Patton and Timmerman (2007) analysed the properties of an optimal forecast under a generalised loss function and discussed how to test for these properties. We make use of these approaches to re-evaluate the issue of rationality of the German business cycle forecasts; namely growth and inflation forecasts covering the time span from 1970 to 2007 and up to 17 different forecasts.

In our results, we find only limited evidence for asymmetric loss functions of German business cycle forecasters. Moreover, the point estimates of the degree of asymmetry are not systematic in any respect: some forecasters seem to have incentives for too-pessimistic forecasts; others, for too-optimistic forecasts. Over and above this, the results appear to be not fully robust against the choice of the instruments warranted to estimate the loss function with an Instrumental Variable (IV) estimator.

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 generalized loss function alter the findings obtained under a symmetric loss function by very much, though 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 2 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 3 tests for the rationality of the forecasts under different assumptions: a symmetric loss function, a specific asymmetric loss function, and a generalised loss function. The final section summarises and concludes.

3. Estimating loss function asymmetry parameters and testing for asymmetry

In the following section we evaluate the forecasts of several institutions that deliver macroeconomic forecasts regarding the German economy. Details on the data set under investigation can be found in Döpke and Fritsche (2006). For all institutions, we have collected the 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 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 present. As a measure of the inflation forecast we use the predicted change of the deflator of private consumption when this figure was available. In some cases, however, no explicit reference was given whether a mentioned 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 used the available inflation forecast. As regards the actual outcome, it is possible to refer to the last 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:

$$L(p,\alpha,\Theta)=[\alpha+(1-2\alpha)\cdot 1(y_{t+1}-\hat{y}_{t+1}<0)]\cdot|y_{t+1}-\hat{y}_{t+1}|^p \quad (1)$$

In this loss function the parameter p represents the underlying assumption of the subsequent analysis. In particular, *p=1* stand 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 consists of a parameter α. It represents 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 too-pessimistic forecasts. Thus, a particular set of parameters leads to well-known loss function. For example $L(1,1/2,\Theta)=(y_{t+1}-\hat{y}_{t+1})^2$ yields a symmetric quadratic loss function (Elliot et al. 2005: 1110). The key problem addressed by Elliot et al. (2005) 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 moment condition for the IV estimator. By observing the sequence of forecasts, the authors propose a GMM estimator that yields the following expression to estimate the asymmetry parameter of the loss function out of the moment condition:

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

with . $\hat{S} = \frac{1}{T} v\, v'(1(y_{t+1}-\hat{y}_{t+1}<0)-\alpha_t)^2 |y_{t+1}-\hat{y}_{t+1}|^{2p_0-2}$ as a weighting matrix. Since *S* depends on α_T , estimation has to be performed iteratively, assuming *S* = *I* 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.

For the proposed GMM estimator instruments are warranted. Following Elliot et al. (2005: 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. This is the set of instruments proposed in the literature, (Elliott et al., 2005; Christodoulakis and Mamatzakis 2008, 2009). The estimation results for the data set under investigation are given in Table 1.

— Insert Table 1 here —

As regards the growth forecasts and the calculations based on the assumption of a lin-lin loss function the findings revealed in Table 1 suggest only very limited evidence for asymmetric loss functions. Only in case of the Berlin Institute do the results point to a loss function giving incentives for too-pessimistic forecasts. Depending on the number instruments there are also some weak (significant at the 10 % level) results for a loss function of the Council of Economic Advisers fostering too-optimistic forecasts. These results may support some conventional wisdom regarding these institutions: the Berlin Institute has long been seen as the most pronouncedly Keynesian among German institutes. Thus, being pessimistic might be plausible to achieve a more activist economic policy. By contrast, the Council of Economic Advisers has widely be seen as very supply-side oriented and the opposite behaviour may be seen as plausible. However, such interpretations are surely exaggerated since other institutes with strong opinions (Trade Union Institute or Employers Institute, for example) show no similar results. The test results are also illustrated by visual inspection of the estimated loss functions. Some pronounced cases of these functions are given in Figure 1 and 2, the others are available upon request from the authors.

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— Insert Figure 1 here —

— Insert Figure 2 here —

Without the mentioned exceptions all 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. For example, in Table 1 for lin-lin function the pooled estimates of asymmetry parameter is close to 0.5 both for the growth and inflation forecasts. This is, because under lin-lin function the estimate of the asymmetry parameter is the share of negative forecast errors.

Turning to the inflation forecasts, there are more hindsights to asymmetric loss functions. The Joint Forecast as well as the Council of Economic Advisers have incentives to overestimate inflation, while the Berlin Institute is more likely to underestimate it. Again, visual inspection of the estimated loss functions in Figure 1 confirms the picture given by the formal statistical tests.

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 for a significant degree of asymmetry across the board of the forecasting institutions (Table 2). However, the picture changes, if the pooled data are used for estimation. As Table 2 reveals, for quad-quad function for individual institutes we find only few cases of rejection of asymmetry for growth forecasts, while the pooled results indicate quite the opposite conclusion indicating a general tendency of forecasters to produce overly optimistic forecasts. This is most likely a reflection of the fact that for all cases but one (Berlin institute) the individual institutes estimates exceed 0.5. By pooling we get a significant gain in testing power. As regards the inflation forecasts pooled test indicates the presence of asymmetry less decisively. 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.[4]

— Insert Table 2 here —

[4] For example, in case of the growth forecasts we have a sum of negative forecast errors of -379.85 and a sum of the positive forecasts errors of 235.80, which gives 379.85/(379.85 + 235.80) = 0.617 for k = 1. The respective numbers for the inflation forecasts are -179.50 (sum of negative forecast errors), 181.45 (sum of positive forecast errors), which leads to 179.5/(179.5+181.45) = 0.497 for k=1.

There are some differences from the lin-lin case, however. First, the Berlin Institute appears to have a symmetric loss function in this case. The autumn forecast of the European Commission, the autumn forecast of the IMF; that of the Halle Institute and, again, the forecast of the Council of Economic Advisers show a significant degree of asymmetry, all pointing to incentives to too-optimistic forecasts. Of course, the results for the Halle Institute should be taken with particular caution, due to the very small number of observations (the Institute was founded in 1992).

As regards the inflation forecasts, four institutions show significant asymmetry: the Joint Forecast in autumn, the Kiel Institute, the Hamburg Institute, and the Trade Unions Institute. All four have a value for the asymmetry parameter, giving incentives for too-high inflation predictions. While this result might meet expectations in all other cases, it might come as a surprise in case of the Trade Unions Institute. However, in all four cases the results have to be taken with great cautiousness since they are not very robust with respect to the choice of the instruments (see section 4.2.2 on this issue).

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

4.1 Testing for rationality under a symmetric loss function

Testing the rationality of a forecasts under a symmetric loss function is typically based on two requirements for the forecast: 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., an optimal forecast one should be unable to find any variable, 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:

$$(y_{t+n} - \hat{y}_{t+n,t}) = a_0 + a_1(\hat{y}_{t+n,t} - y_t) + u_{t+n} \qquad (3)$$

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.

— Insert Table 3 here —

The results, documented in 3, give little hints of departures from rationality. In case of the growth forecasts only the Halle Institute shows a significant rejection of the null hypothesis of forecast rationality. This comes as no real surprise, since the Halle Institute was not (re-)founded before

1991, joining the forecast club in 1993. The resulting very short sample reminds to be extremely cautious in interpreting this result. Turning to the inflation forecasts, four institutions show a significant rejection of the null hypothesis. Again, the Halle Institute is among them, but this might be due to the very short sample. Since the IMF forecasts are delivered relatively early as compared to the other forecasts, the non-rationality of these forecasts might be a result of the slightly longer forecast horizon. The other results remain to be explained.

4.2 Rationality testing under an asymmetric loss function

4.2.1 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:

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

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 defines 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 line loss function the optimal forecast has a clearly defined bias. This bias, in turn, depends on the volatility of the time series to be foretasted and has an analytical expression for the linex loss function. Thus, to test for rationality, an additional term in the test equation is warranted that reflects the expected value of the conditional error variance:

$$(y_{t+1}-\hat{y}_{t+1,t})=a_0+a_1(\hat{y}_{t+1,t}-y_t)+\frac{\delta}{2}E_t(\sigma^2_{t+1})+u_{t+1} \tag{4}$$

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 to estimate an ARCH-in-Mean model, tracing back to 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 to the data. It turned 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:

$$\begin{gathered}(y_{t+1}-\hat{y}_{t+1,t})=a_0+a_1(\hat{y}_{t+1,t}-y_t)+a_2E_t(\sigma^2_{t+1})+u_{t+1}\\ u_{t+1}\sim N(0,\sigma^2_{t+1})\\ \sigma^2_{t+1}=c_1+c_2u^2_{t+1}+c_3\sigma^2_t\end{gathered} \tag{5}$$

As in the original contribution of Batchelor and Peel (1998) the ARCH-in-Mean terms turn out to be insignificant in most of the cases here. However, the presence of this term might 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 virtually all cases the null of rationality cannot be rejected for the growth forecasts considered in this paper. The results change, when considering the inflation forecast errors; however, again the results do not differ qualitatively from the case of a symmetric loss function.

— Insert Table 4 here —

4.2.2 The Elliot et al. (2005) approach

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

$$J = \frac{1}{T}\left[\begin{array}{l}\left(\sum_{t=\tau}^{T+\tau-1} \upsilon_t\left[1(y_{t+1} - \hat{y}_{t+1} < 0) - \alpha_T\right]\left|y_{t+1} - \hat{y}_{t+1}\right|^{p_0-1}\right)' \hat{S}^{-1} \\ \cdot\left(\sum_{t=\tau}^{T+\tau-1} \upsilon_t\left[1(y_{t+1} - \hat{y}_{t+1} < 0) - \alpha_T\right]\left|y_{t+1} - \hat{y}_{t+1}\right|^{p_0-1}\right)\end{array}\right] \sim \mathrm{X}^2_{d-1} \qquad (6)$$

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

— Insert Table 5 here —

In case of growth forecasts and the lin-lin setting, the null hypothesis has to be rejected only in very few cases. In particular, for the IMF (autumn forecast), the OECD, and the Council of Economic Advisers the hypothesis is not supported by the data. However, in none of the three cases, the result appears to be robust with respect to the choice of the instruments. Thus, the hints for 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 3, one might suspect that the rejection is due to the failure of the rationality hypothesis rather than due to 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, all in all, 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 is frequently rejected, when the lagged forecast errors are used as instruments which implies 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 (k=2), both for pooled and for 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 case of inflation we have for all sets of IV decisive rejection of forecast rationality, corroborating with most of evidence from individual GMM. Observe that the magnitude of pooled J-test statistics for inflation by far exceeds that for growth forecasts, which is also in line with more strong evidence against forecast rationality observed from individual J-tests.

5. Conclusion

The paper analyses the degree of asymmetry of German business cycle forecasts, namely growth and inflation forecasts covering the time span from 1970 to 2007 and up to 17 different forecasts. 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 too-pessimistic forecasts, some others for too-optimistic forecasts. 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 do not exclusively rely on the assumption of a symmetric loss function, but 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 generalized loss function alter the findings obtained under a symmetric loss function by very much, though the results of the test proposed by Elliot et al. (2005) give some contrary results for inflation forecasts. All in all, we can decisively detect an asymmetric loss function only in case of GDP forecasts (tendency to produce over-optimistic forecasts) and 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. However, by pooling the data we get an opposite conclusion, i.e. the 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 conform with those obtained by pooling the data. Our results extends, therefore, previous research, which found growth forecasts to be inefficient (see, e.g. Dovern and Weissner (2008), Osterloh (2008) and Ager et al. (2009)) to the case of a more general assumption regarding the underlying loss function.

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

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Table 1: Evidence for an asymmetric loss function, lin-lin function

	$\alpha_L=1$	s.e.	p-value	$\alpha_L=2$	s.e.	p-value	$\alpha_L=3$	s.e.	p-value	$\alpha_L=4$	s.e.	p-value
Panel (A): growth forecasts												
Berlin institute	0,324	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
Employer's 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
Governments' 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
Join 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 Unions' 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
Panel (B): 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
Employer's 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
Governments' 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 Unions' 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

Table 2: Evidence for an asymmetric loss function, quad-quad loss function

	$\alpha_L=1$	s.e.	p-value	$\alpha_L=2$	s.e.	p-value	$\alpha_L=3$	s.e.	p-value	$\alpha_L=4$	s.e.	p-value
Panel (A): growth forecasts												
Berlin institute	0,49	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
Employer's 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
Governments' 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 unions' 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
Panel (B): 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	0,14
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
Governments' 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 unions' 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

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
Employer's Institute a)	-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 b)	-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 c)	-0.660 (-2.08)	0.007 (0.04)	2.55	0.09
IMF, spring d)	-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 Unions' Institute	-0.086 (-0.33)	-0.055 (-0.32)	0.098	0.91

a)1972 to 2007; b) 1993 to 2007; c) 1973 to 2007; d) 1971 to 2007.

Table 3: continued

	Constant	Slope	Test for rationality (F-value)	Test for rationality (p-value)
		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
Employer's Institute [a)]	-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 [b)]	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
IMF, autumn [c)]	-0.127 (-0.89)	0.289 (1.86)	2.344	0.11
IMF, spring [d)]	-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 Unions' Institute	-0.014 (-0.09)	0.547 (3.92)	7.96	0.002

a)1972 to 2007; b) 1993 to 2007; c) 1973 to 2007; d) 1971 to 2007.

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		
Employer's Institute a)	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 b)	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 c)	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 d)	Coefficient	-1.15	-0.04	1.38	0.27
	t-value	-1.69	-0.08		
IMF, spring e)	Coefficient	0.06	0.16	1.38	0.27
	t-value	0.27	0.55		
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 Unions' Institute	Coefficient	0.15	0.04	1.68	0.20
	t-value	0.91	0.16		

a)1972 to 2007; b) 1993 to 2007; c) 1973 to 2007; d) 1971 to 2007. e) Convergence could only be achieved after eliminating the year 1975 by a dummy variable in the mean equation.

Table 4: continued

		Constant	Slope	Test for rationality (F-value)	Test for rationality (p-value)
				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		
Employer's Institute [b)]	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 [c)]	Coefficient				
				Convergence failed	
Hamburg Institute	Coefficient	-0.70	-0.21	0.27	0.76
	t-value	-1.15	-0.71		
IMF, autumn [a)]	Coefficient	-1.15	-0.04	2.28	0.12
	t-value	-1.69	-0.08		
IMF, spring [d)]	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 Unions' Institute	Coefficient	0.15	0.04	2.67	0.08
	t-value	0.91	0.16		

a)1972 to 2007; b) 1993 to 2007; c) 1973 to 2007; d) 1971 to 2007.

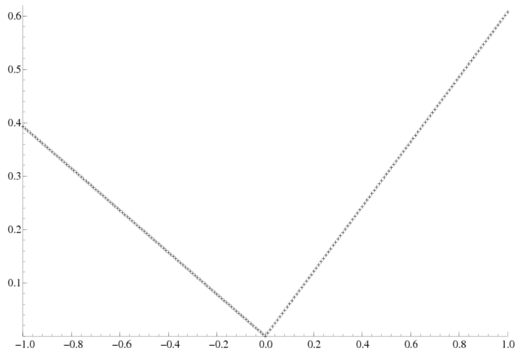
Table 5: Joint test for forecast rationality and loss function (J-test), lin-lin function, 1970 to 2007

	J-test k=2	p-value	J-test k=3	p-value	J-test k=4	p-value
			Panel (A): 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 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 Unions' 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
			Panel (b): 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 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's Institute	5,23	0,02	0,03	0,86	7,59	0,02
Pooled data	62,23	0	19,85	0,00	62,42	0,00

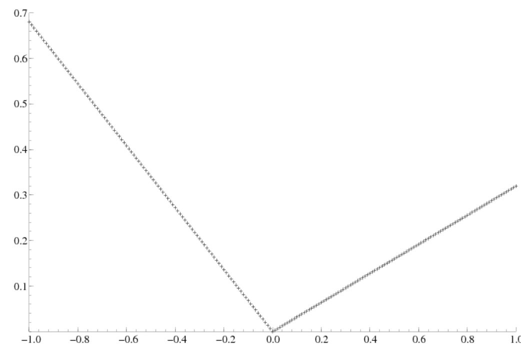
Table 5, cont: Joint test for forecast rationality and loss function (J-test), quad-quad function, 1970 to 2007

	J-test k=2	p-value	J-test k=3	p-value	J-test k=4	p-value
			Panel (A): 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 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 Unions' 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
			Panel (B): 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
Employer's 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 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's 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

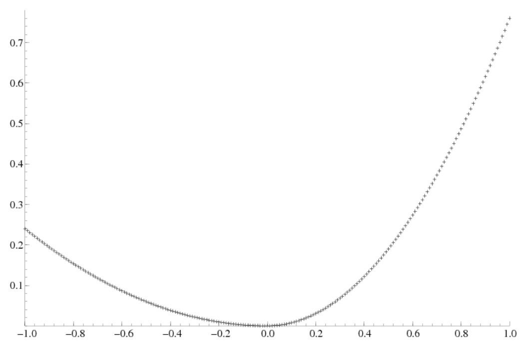
Figure 1: Selected estimated loss functions, growth forecasts



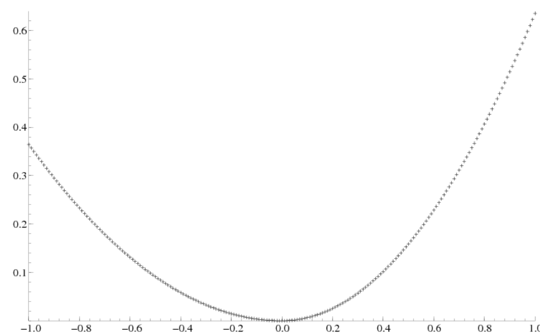
Council of economic advisers



Berlin institute

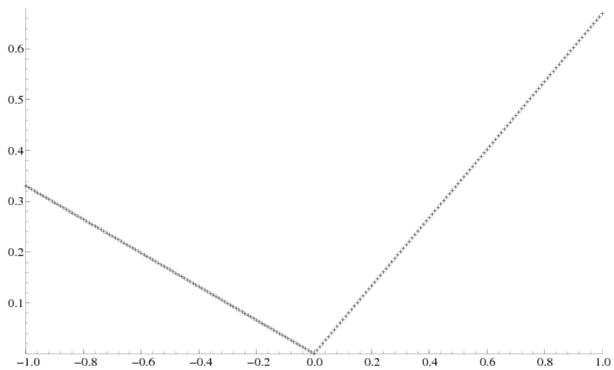


IMF, autumn

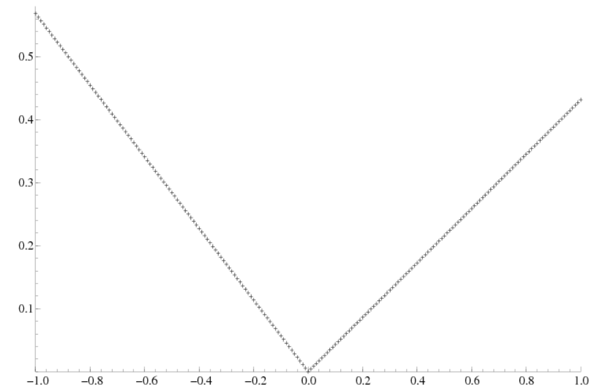


Pooled data

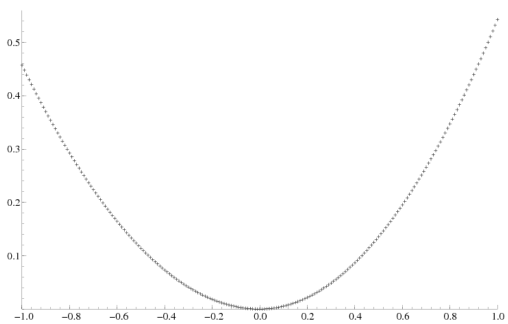
Figure 2: Selected estimated loss functions, inflation forecasts



Joint forecast, autumn



Kiel institute



Pooled data