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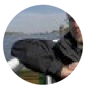
ARTICLE *in* INTERNATIONAL JOURNAL OF FORECASTING · FEBRUARY 2006

Impact Factor: 1.49 · DOI: 10.1016/j.ijforecast.2005.05.006 · Source: RePEc



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International Journal of Forecasting 22 (2006) 125–135

international journal of forecasting

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When do forecasters disagree? An assessment of German growth and inflation forecast dispersion

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Abstract

Based on a panel of German professional forecasts for 1970–2004 we analyse the dispersion of growth and inflation forecasts. Forecast dispersion varies over time and is particularly high before and during recessions. There is no clear link between forecast dispersion and the subsequent forecast error. Forecast dispersion is positively correlated with the volatility of macroeconomic variables, but not necessarily with the level of the same variables. We interpret this finding to be evidence in favour of the notion that forecasters do not share a common belief about what is an adequate model of the economy. In particular, the assessment of the effects of monetary policy seems to be the prime suspect for diverging beliefs regarding an appropriate model of the economy.

JEL classification: E32; E37; C52; C53

Keywords: Consensus forecast; Disagreement; Uncertainty; Germany

1. Introduction

While a lot of studies refer to the quality of individual forecasts or to those of a very small group of institutions,[2] there is (to our knowledge) no study which examines the forecasts of a larger group of German institutions. Furthermore, there has been no study which deals mainly with the dispersion of German macroeconomic forecasts. The present study tries to fill this gap by taking into account the predictions of all forecasters that provide forecasts for Germany for a long time span, i.e., from (at least) the early 1970s onwards. We use annual data for growth and inflation forecasts from 1970 to 2004, coming from up to 17 different forecasts. This novel data set makes it possible to test whether the dispersion of forecasts might potentially provide useful information. To this end, we analyse whether there was indeed a consensus among German forecasters.

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[2] For an overview of recent work on German business cycle forecasts see Heilemann and Stekler (2003) and the literature cited therein.

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doi:10.1016/j.ijforecast.2005.05.006

However, the main aim of our paper is to shed light on some of the reasons for disagreement among forecasters. Several reasons may lead forecasters to disagree.[3] First, forecasters may have different knowledge about the current state of the economy at the time that the forecast is made, i.e., the "ragged edge" problem (Wallis, 1986). Second, they may rely on different assumptions on the path of variables, which are in most cases exogenous to the forecasting process, e.g., oil prices or the course of economic policy. Third, if the forecasters agree on these variables they may still disagree about the appropriate model of the economy and its adjustment dynamics. Fourth, we cannot rule out some influence of strategic behaviour of forecasters (Laster, Bennett, & Geoum, 1999). Last, some authors argue that the dispersion of forecasts might be interpreted as a measure of uncertainty of the forecast. Our data set allows us to shed light on some of these hypotheses.

First, if the bulk of the forecast dispersion reflects diverging models and interpretations of the current macroeconomic situation by the different forecasters,[4] the dispersion of inflation and growth forecasts should vary depending on the respective state of the economy. Second, we analyse the impact of macroeconomic variables and their volatilities on forecast dispersion. We expect a positive correlation between the volatility of macroeconomic variables and dispersion, since volatile macroeconomic variables may reflect underlying shocks hitting the economy.

The paper is organised as follows: Section 2 describes the data set used and tests for a consensus among forecasters. Section 3 discusses forecast dispersion and the underlying reasons for disagreement. In particular, we test whether the level/change of macroeconomic variables or the respective volatility helps to explain forecaster disagreement. Section 4 concludes.

2. Is there a consensus among German forecasters?

2.1. Data and sources

We have collected the growth and inflation forecasts of 14 institutions that made forecasts regarding the German economy. 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).[5] In the case of interval forecasts the average is used. The numbers refer to West Germany up to 1992, and to the unified Germany from 1993 to present. The inflation forecast is the predicted change of the deflator of private consumption. In some cases, however, no explicit reference was given as to whether a mentioned inflation forecast referred to the consumption deflator or to the CPI. In such cases, we assumed that there was no distinction between the figures and used the published inflation forecast. The actual outcome was based on the first published ("real time") data.

Table 1 lists the names of the 14 institutions and also presents the horizon of each institution's forecast. It is apparent that the forecast horizons differ among forecasters. However, the pattern of forecasts during a year is, with very minor exceptions, rather stable in Germany. Thus, while it is true that some forecast dispersion comes simply from the differing forecasting dates, this part of forecast dispersion is stable over time. This should not influence our measures of dispersion.[6]

2.2. Defining and testing for a consensus

Fig. 1 shows the time path of the dispersion of the growth and inflation forecasts. We use two measures of forecast dispersion: the standard deviation of the fore-

[3] For Germany, German unification may also be seen as an important source of forecast dispersion. However, as the data collected and analysed by Heilemann (1999) make clear, despite the enormous uncertainty over the economic situation in East Germany the dispersion of forecasts regarding East Germany was not particularly large. Thus, our decision to refer to German data from some year onwards will not affect our results concerning forecast dispersion.

[4] As one referee argued, different models and different assumptions about exogenous variables made by the forecasters might theoretically lead to the same forecast result. This is, of course, right: the case that these errors exactly cancel out might nevertheless be seen as a special case because we assume that the assumptions about exogenous variables do not differ in a systematic manner.

[5] Sometimes the forecasts refer to "growth" rather than explicitly to either GDP or GNP. In this cases we have assumed that the forecasters made no distinction between the concepts and had the same forecast for both figures.

[6] In other words: we expect all forecasts to be consistent, while the efficiency of the forecasts differs due to the differences in horizons.

Table 1
Institutions and forecasts under investigation

Institution	Source of forecast	Start/ending dates of forecasts	Average number of months until end of forecast horizon	Additional notes
Council of Economic advisors	*Sachverständigenrat*, annual reports, several years, Wiesbaden	1970–2004	13	
Joint forecast of the six (formerly five) "leading" German economic research institutes, autumn forecast	*Arbeitsgemeinschaft wirtschaftswissenschaftlicher Forschungsinstitute*, various issues, Berlin	1970–2004	14	
Joint forecast of the six (formerly five) "leading" German economic research institutes, autumn forecast	*Arbeitsgemeinschaft wirtschaftswissenschaftlicher Forschungsinstitute*, various issues, Berlin	1970–2004	8	
German Institute of Economic Research (DIW Berlin)	German Institute of Economic Research (ed), Economic Bulletin, various issues, Berlin	1970–2004	11	Two forecasts per year, we refer to the one in January only
Kiel Institute for World Economics (IfW)	"*Die Weltwirtschaft*", various issues, Kiel	1970–2004	12	No forecasts for 1975 and 1976 (see Stege (1989) for a discussion of possible reasons) We use numbers from the joint forecast for these years, since the Kiel Institute was part of the joint forecast. For forecasts, we use the December forecast
HWWA Institute of Economic Research, Hamburg	"*Wirtschaftsdienst*", various issues, Hamburg	1970–2004	12	Two forecasts per year, we refer to the autumn forecast
Ifo Institute, Munich	"*Ifo Schnelldienst*", various issues	1970–2004	12	
Institute for Economic Research Halle (IWH)	"*Wirtschaft im Wandel*", various issues, Halle/Saale	1995–2004	11	Institute founded in 1993
Rhine-Westphalia Institute for Economic Research (RWI), Essen	Institute's "Economic report"	1970–2004	11	
OECD	Economic Outlook, various issues, Paris	1974–2004	13	Two forecasts, we use the autumn forecast
IMF, spring forecast	World Economic Outlook, various issues, Washington	1974–2004	9	Some forecasts have not been published. Here we use the data collected by Artis (1987)
IMF, autumn forecast	World Economic Outlook, various issues, Washington	1974–2004	15	Some forecasts have not been published. Here we use the data collected by Artis (1987)
European Commission, spring forecast	European Economy, various issues, Brussels	1974–2004	9	
European Commission, autumn forecast	European Economy, various issues, Brussels	1974–2004	14	
Trade Union Institute (WSI)	*WSI Mitteilungen*, various issues, *Düsseldorf*	1974–2004	12	In 2001 no growth forecast and in 2001 and 2002 no inflation forecasts
Institute of the German Economy (IW)	*IW-Trends*, various issues, *Cologne*	1970–2004	13	
Economic report of the German federal government	*Jahreswirtschaftsbericht*, various issues, Bonn/Berlin	1970–2004	10	

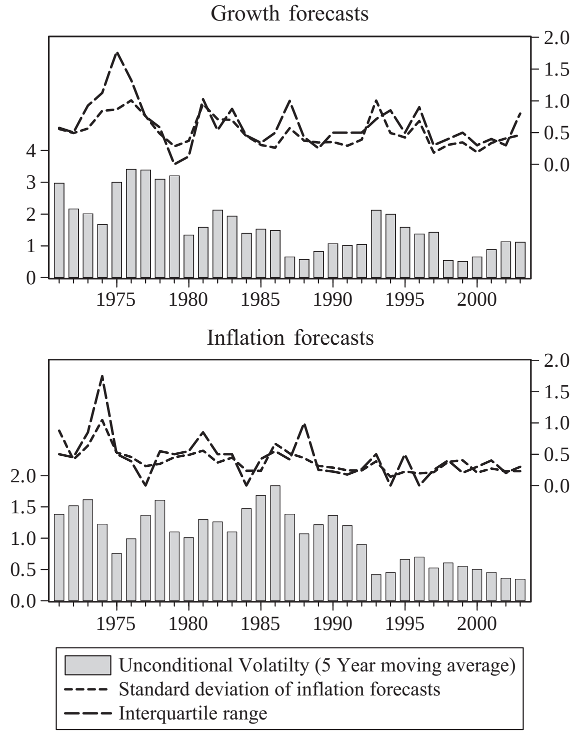

Fig. 1. Forecast dispersion and unconditional volatility 1971 to 2004.

casts and, to exclude the possibility of outlier observations causing distortion, the interquartile range.

While there may be some disagreement among the forecasters, the predictions may be close enough that they constitute a "consensus". We, therefore, examine each year's forecasts to determine whether there is a consensus among the forecasters.

Many forecast evaluations have used the mean (or median) of a set of forecasts and called it the "consensus" forecast (see, e.g., Gavin, 2003). Kolb and Stekler (1996) suggested a different procedure to test for the existence of a consensus in our data set: "A set of forecasts can be said to generate a consensus only if the uniform distribution is rejected and normality is not rejected (. . .)" (Kolb & Stekler, 1996, p. 458). However, even if the hypothesis of normality is rejected, a consensus is still possible, since the forecasters may even be closer together than normality implies. To check this possibility, the results of tests for skewness and kurtosis are calculated. If the distribution is skewed, a consensus is rejected. If the distribution is not skewed, a significant kurtosis above 3 indicates that the forecasters are very close to each other. Thus, this case is also counted as a consensus. We use this procedure in our analysis.

The results of this exercise are given in Table 2. Based on a 10% significance level for all tests the hypothesis of a consensus for growth forecasts can be rejected for seven years. In the case of the inflation forecasts the hypothesis of a consensus among forecasters is rejected 10 times. For these years the disagreement among forecasters is particularly large.

Even though a consensus exists in most of the years, it is appropriate to determine whether there was information in the "minority reports". We, therefore, checked whether, in a certain year, all forecasters agreed on the direction of change. Subsequently, we tested for the information content of both the majority and the minority forecast using a test statistic outlined by Diebold and Lopez (1996, p. 257). If "A" stands for acceleration and "D" for deceleration and the first sub-index denotes the predicted value and the second one the actual outcome, the information content of a forecast can be summarised using the measure $I=(O_{AA}/(O_{AA}+O_{AD}))+(O_{DD}/(O_{DD}+O_{DA}))$. In a pure coin flip case we have $O_{AA} \approx O_{AD}$ and $O_{DD} \approx O_{AD}$ and therefore $I \rightarrow 1$. If the forecast is perfect than $O_{AD}=O_{DA}=0$ and $I=2$. Therefore, any value of $1<I \leq 2$ indicates a positive information content. The test statistics in Table 3 refer to the years with a minority report only. For all other years, the information content is equal by definition.

It appears that there are 9 (14) years in which a minority of forecasters (i.e., at least two) disagrees on the question whether growth (inflation) will speed up or not. Table 3 gives a measure of the information content for both groups of forecasts.[7] In the case of the growth forecasts, the minority provides as much information as the majority. However, the information content in both cases is not different from the coin flip case. Whereas the majority has one time more often predicted an acceleration of growth correctly, the opposite holds true for decelerations. According to the implied information content, it does not matter to whom the user of the forecasts listens. In case of the inflation forecasts, however, the rational consumer of forecasts should rely on the opinion of the majority.

[7] For years without a minority report, the direction-of-change forecast is the same for both groups of forecasters.

Table 2
Tests for a consensus among forecasters

Year	Years tested	Hypothesis of uniform distribution rejected=possible consensus	Hypothesis of normal distribution rejected at the 10% level=possibly no consensus	Hypothesis of normal distribution rejected at the 10% level, and hypothesis of zero skewness rejected=no consensus	Hypothesis of normal distribution rejected at the 10% level, but distribution not skewed, and kurtosis (sig.) >3=consensus	Rejection of the hypothesis of a consensus at 10% level for the years
Growth forecasts	35	35	9	5	2[a]	1971, 1979, 1981, 1983, 1986, 1993, 1995
Inflation forecasts	35	35	14	10	2[b]	1971, 1977, 1981, 1984, 1987, 1988, 1994, 1995, 1996, 2000

The tests are: a Komolgorov test of the hypothesis that all forecasts are from a uniform distribution between − 2 and 6, a Shapiro–Silk test for normality, skewness, and kurtosis, respectively.

[a] 1986 and 1993 appear to be borderline cases, since normality is rejected at the 10% level, the distributions appear not to be skewed and the kurtosis is above 3, but not significant. All in all, we counted the years not as a consensus at the 10% level.

[b] 2001 is a borderline case. Normality is rejected, the distribution is not skewed and the kurtosis exceeds 3, but is insignificant. The year was nevertheless counted as a consensus.

Table 3
Directional forecast errors: majority vs. minority 1971 – 2004

Error type	Majority	Minority[a]
Predicted/outcome		
Growth forecasts (number of minority reports: 11)		
Acceleration/acceleration	2	1
Acceleration/deceleration	4	2
Deceleration/acceleration	2	4
Deceleration/deceleration	1	2
Information content	1.00	1.00
Inflation forecasts (number of minority reports: 14)		
Acceleration/acceleration	4	2
Acceleration/deceleration	2	6
Deceleration/acceleration	5	2
Deceleration/deceleration	3	4
Information content	1.29	0.71

[a] A minority report is counted as at least two forecasts out of all the forecasts disagreeing with respect to the predicted acceleration/deceleration.

Despite the fact that minority reports are more frequent as regards inflation, the minority provides substantially less information than the majority.

3. The assessment of forecast dispersion

3.1. Forecast dispersion over time

Apparently, forecaster disagreement seems to decline slightly over time. This finding holds true for both the growth and inflation forecasts. According to the interpretation of disagreement as a measure of uncertainty, this would imply that forecast uncertainty is lower recently than it was in the years before. While this viewpoint is in line with the declining volatility of the German business cycle also visible in Fig. 1 (see also Fritsche & Kouzine, 2003) it is not quite clear whether this matches the forecasting success.[8]

Moreover, though there is no obvious theoretical link between the dispersion of forecasts and the state of the business cycle, it can be seen from the exhibit that the variance of the forecast is relatively high during recessions and early upswings (e.g., 1975,

[8] Over the same time span, average growth and inflation rates declined as well. This could have repercussions on the dispersion of forecasts as well.

1982–1984, 1994, 1996). As a test for this hypothesis we run the following regression:

$$\log(\sigma_t^{\mathrm{f}}) = \beta_0 + \beta_1 D_{t-1}^{\text{Recession}} + \beta_2 D_t^{\text{Recession}} + \beta_3 D_{t+1}^{\text{Recession}} + \beta_4 \text{Trend} + u_t \quad (1)$$

where we regressed the disagreement measure (here: log of the standard deviation of the forecasts) on impulse dummies for recession periods. Leads and lags were included to capture the argument of pre-recession uncertainty and early upswings. The business cycle dating was taken from the Economic Cycle Research Institute.[9] A deterministic time trend was included to control for the possibility of a decreasing business cycle volatility. As can be seen from Table 4, the dummies capture a lot of the dispersion in the case of growth forecasts prior to and during a recession and the coefficients turn out to be significant. The coefficient for the early upturn dummy is negative, which indicates a strong consensus in these periods and a dispersion clearly below average. There seems to be no significant relationship between recessions and the dispersion of inflation forecasts.

Table 4
Forecast dispersion and the state of the business cycle 1970–2004

	Dispersion of growth forecasts	Dispersion of inflation forecasts
Constant	−0.28 (0.13)**	−0.17
Business cycle dummy ($t-1$)	0.43 (0.08)***	−0.15 (0.15)
Business cycle dummy (t)	0.20 (0.08)***	0.21 (0.10)*
Business cycle dummy ($t+1$)	−0.27 (0.13)*	−0.01 (0.13)
Trend	−0.02 (0.004)***	−0.03 (0.005)***
R^2	0.55	0.52
Test for normality (p-value)[a]	0.65	0.51
Test for autocorrelation up to order 2 (p-value)[b]	0.18	0.65
Test for heteroskedasticity (p-value)[c]	0.82	0.42

t-values (calculated with robust standard errors using the method of Newey & West, 1987) in brackets. *** (**, *) denotes rejection of the null hypothesis at the 1% (5%, 10%) level. (a) Jarque–Bera test for normality; (b) Breusch/Godfrey test for autocorrelation; (c) White test for heteroskedasticity.

Thus, we find an influence of the state of the business cycle on growth, but not on inflation forecasts. These results might reflect that, on the one hand, forecasters frequently disagree on the average or current length of a cycle and, as a consequence, on the question of whether the next phase of the cycle is just around the corner. On the other hand, some recent evidence suggests (Orphanides & Van Norden, 2003 for US data; Döpke, 2004, for German data) that the state of the cycle taken by itself (measured, e.g., in terms of the output gap) might not be a particularly good indicator for inflationary pressures, at least in real time. Thus, forecasters should not lay too much weight on these figures when making their mind up regarding future inflation.

3.2. Forecast dispersion as a measure of uncertainty?

Since the forecast dispersion varies over time, the question arises as to whether this measure is a proxy for forecast uncertainty. While uncertainty is usually attributed to individual forecasts (Zarnowitz & Lambros, 1987), it is possible that the cross-section variance might be a useful measure of uncertainty (see Linden, 2003). There is, however, disagreement about the validity of this procedure (see Bomberger, 1996; Rich & Tracy, 2003). To examine this hypothesis with our data set, we regress the dispersion of the forecasts against the absolute forecast errors of the mean and median forecasts. If disagreement is indeed a useful measure of uncertainty, one would expect a positive correlation with the subsequent forecast error. Besides the standard deviation of the forecasts, we also take into account the skewness of the forecasts. A positive skewness implies a long right tail of the distribution of the forecasts. In other words, the vast majority of the forecasters remain sceptical, but a considerable minority has more optimistic forecasts. Unfortunately, our results[10] do not support the hypothesis that dispersion is a reasonable measure of forecast risk or uncertainty.

3.3. Forecast dispersion and the measured variance of macroeconomic variables

This section is devoted to studying the circumstances under which forecasters disagree. The ques-

[9] We refer to the business cycle concept. A year was counted as a recession year if more than 6 months were in the recession regime. The Internet source is http://www.businesscycle.com/.

[10] The results are available from the authors.

tion is important because it is commonly assumed in economic analyses and models that economic agents share identical beliefs about the structure of the economy. In order to determine whether this is correct, we question whether either the levels or rates of change of major macroeconomic variables can explain the observed dispersion. In particular, we hypothesize that variables that are associated with shocks can affect dispersion. We consider three kinds of shocks: monetary, demand or spending, and supply (Taylor, 2000). In particular, the following variables were chosen to reflect those shocks:

(a) Variables possibly related to monetary shocks:
 - Nominal short-term interest rates.
 - The interest rate spread, which is frequently referred to as one of the important business cycle leading indicators (see, e.g., Estrella, Rodrigues, & Schich, 2003).
 - Two measures of monetary shocks. The first one is the real short-term interest rate.[11] A second measure is based on a structural VAR that disentangles expected real interest rates into that part driven by monetary policy and that part reflecting other sources.[12]

(b) Variables possibly related to demand shocks:
 - Real exchange rates, since an increase of real exchange rates is likely to dampen net exports.
 - The overall stock market index. This variable can be also rationalised as a measure of overall uncertainty, but it will also reflect the burst of a stock market bubble.
 - Industrial production in OECD countries. This number gives a proxy for external demand.
 - The change of structural budget deficits. This is a measure of the stance of fiscal policy.

(c) Variables possibly related to supply shocks:
 - Oil prices. Oil price changes are probably an uncontroversial type of supply shock that may drive the cycle.
 - Labour productivity. Some researchers argue that unpredictable changes in labour productivity are the underlying reasons for business cycles. While this may or may not be true, the German research and forecasting institutions certainly do not agree upon this. Thus, in the face of high productivity volatility, they might disagree on the forecast to be made.
 - Real wages. Real wages are related to productivity and the state of the business cycle. As with labour productivity, real wage developments represent an area of strong disagreement between forecasters. Therefore, the forecasters might disagree when the magnitude of real wage changes is high.

We investigate the impact of macroeconomic variables on forecast dispersion using regressions of the type:

$$\log\left(\sigma_t^{\mathrm{f}}\right) = \beta_0 + \beta_1 X_{t-1}^{\mathrm{macro}} + u_t \tag{2}$$

where X represents the respective macroeconomic variable. In the case of non-stationary variables we calculated the respective growth rates to ensure that the regression is balanced. Using the log of the volatility as the dependent variable takes into account that it is bounded to be larger than zero.

In most cases, there is no significant relationship between either the rate of change or the level of the macro-variables and the degree of forecast dispersion. The few cases that yielded significant results are presented in Table 5. Forecasters tend to disagree on the growth forecasts when there are periods of high inflation rates and high short-term interest rates. The second monetary shock also appears to be significant, at least at the 10% level. This suggests that divergent views on the impact that monetary policy has on the economy is a possible source of dispersion. As regards the inflation forecasts, a rapid growth in real wages and high interest rates contribute to the disagreements as well as, again, short-term interest rates and the inflation rate itself. These findings are consistent with a diverging assessment of inflation persistence across forecasters.

The results indicate that knowledge of the state of the economy in $t-1$, i.e., when the forecasts are pre-

[11] This rate was, however, corrected for low-frequency shifts and high-frequency noise using a band-pass filter according to Baxter and King (1995) who proposed concentration on business cycle fluctuations between 6 and 32 quarters.

[12] See St-Amant (1996) and Gottschalk (2001) for this approach. The identification scheme relies on the applicability of the Fisher equation and uses long-run restrictions as in Blanchard and Quah (1989).

Table 5
Forecast dispersion and macroeconomic variables 1971–2004

Exogenous variable	Constant	Slope	R^2
Growth forecasts			
Short-term interest rates	−1.50 (−9.77)***	0.11 (5.48)***	0.34
Monetary shock measure 1	−0.82 (−7.37)***	0.06 (1.09)*	0.02
Change of stock market index	−0.80 (−6.83)***	−0.01 (−1.14)*	0.04
Change of OECD industrial production	−0.73 (−6.73)***	−0.04 (−1.93)*	0.08
Inflation rate	−1.40 (−9.67)***	0.18 (5.28)***	0.49
Inflation forecasts			
Short-term interest rates	−1.43 (−8.67)***	0.07 (2.07)*	0.14
Change of real wages	−1.22 (−9.64)***	0.09 (2.73)**	0.15
Inflation rate	−1.33 (−7.63)***	0.09 (1.99)**	0.16

For the sake of brevity we report only results where the slope coefficient appears to be significant at least at the 10% level. *t*-values (calculated with robust standard errors using the method of Newey & West, 1987) in brackets. *** (**, *) denotes rejection of the null hypothesis at the 1% (5%, 10%) level.

pared, does not provide any information about assumptions, models, or adjustment dynamics. Thus, the results are not too surprising since the level or the rate of change of a particular variable reflects only limited information on the shocks that hit the economy.

3.4. Forecast dispersion and the volatility of macroeconomic variables

Even though the level and rate of change of most macroeconomic variables did not explain the dispersion, the forecasters' disagreement may be a function of the volatility of these variables. If the disagreements are based on different theories that underlie their predictions, one would expect to find a positive impact of macroeconomic volatility on forecasters' disagreement. Consider, for example, the ongoing debate on the impact that monetary policy has on business cycle fluctuations. If the forecasters have different opinions on the quantitative impact that short-term interest rate changes have on the cycle, they should particularly disagree when the volatility of interest rates is high. On the other hand, if the forecasters disagree for purely tactical reasons (e.g., to gain attention from the media) such a correlation is less likely.

Table 6
Forecast dispersion and macroeconomic volatility—growth forecasts 1971–2004

Exogenous variable	Constant	Slope	R^2
Volatility of short-term interest rates, GARCH	−0.82 (−12.96)***	0.28 (3.88)***	0.33
Volatility of short-term interest rates, rate of change	−0.82 (−13.29)***	0.25 (5.374)***	0.29
Volatility of interest rate spread, GARCH	−0.82 (−11.72)***	0.26 (3.86)***	0.29
Volatility of interest rate spread, rate of change	−0.82 (−11.26)***	0.25 (4.82)***	0.22
Volatility of monetary shock measure 1, GARCH	−0.82 (−13.04)***	0.32 (4.94)***	0.35
Volatility of monetary shock measure 1, rate of change	−0.82 (−13.50)***	0.37 (4.88)***	0.42
Volatility of monetary shock measure 2, GARCH	−0.83 (−12.34)***	0.31 (3.79)***	0.32
Volatility of monetary shock measure 2, rate of change	−0.83 (−12.66)***	0.35 (3.62)***	0.34
Volatility of real exchange rates, GARCH	−0.82 (−9.97)***	0.28 (3.74)***	0.22
Volatility of real exchange rates, rate of change	−0.82 (−9.55)***	0.25 (4.28)***	0.17
Volatility of stock market index, GARCH	−0.84 (−8.58)***	−0.17 (−2.17)**	0.09
Volatility of stock market index, rate of change	−0.82 (−7.80)***	−0.11 (−1.60)	0.04
Volatility of OECD industrial production, GARCH	−0.83 (−9.39)***	0.22 (4.11)***	0.22
Volatility of OECD industrial production, rate of change	−0.78 (−9.62)***	0.25 (4.28)***	0.22
Volatility of budget deficits, GARCH	−0.83 (−7.14)***	0.05 (0.59)	0.01
Volatility of budget deficits, rate of change	−0.83 (−7.12)***	0.02 (0.39)	0.00
Volatility of labour productivity, GARCH	−0.83 (−10.47)***	0.26 (3.66)***	0.26
Volatility of labour productivity, rate of change	−0.83 (−7.21)***	0.02 (0.42)	0.00
Volatility of oil price changes, GARCH	−0.83 (−7.60)***	0.09 (1.13)	0.01
Volatility of oil price changes, rate of change	−0.83 (−7.39)***	0.03 (0.63)	0.00
Volatility of real wages, GARCH	−0.77 (−8.79)***	0.32 (2.47)**	0.20
Volatility of real wages, rate of change	−0.81 (−9.16)***	0.26 (3.31)***	0.20

t-values (calculated with robust standard errors using the method of Newey & West, 1987) in brackets. ***, ** denotes rejection of the null hypothesis at the 1%, 5% level.

Table 7
Forecast dispersion and macroeconomic volatility—inflation forecasts 1971–2004

Exogenous variable	Constant	Slope	R^2
Volatility of short-term interest rates, GARCH	−1.03 (−12.54)***	0.26 (5.08)***	0.33
Volatility of short-term interest rates, rate of change	−1.03 (−12.33)***	0.25 (3.89)***	0.28
Volatility of interest rate spread, GARCH	−1.02 (−11.68)***	0.24 (4.43)***	0.30
Volatility of interest rate spread, rate of change	−1.03 (−12.23)***	0.27 (4.41)***	0.31
Volatility of monetary shock measure 1, GARCH	−1.03 (−12.01)***	0.26 (4.30)***	0.27
Volatility of monetary shock measure 1, rate of change	−1.03 (−12.19)***	0.26 (4.43)***	0.26
Volatility of monetary shock measure 2, GARCH	−1.03 (−11.43)***	0.25 (5.73)***	0.24
Volatility of monetary shock measure 2, rate of change	−1.03 (−11.10)***	0.24 (3.85)***	0.19
Volatility of real exchange rates, GARCH	−1.04 (−9.80)***	0.15 (3.15)***	0.08
Volatility of real exchange rates, rate of change	−1.04 (−9.52)***	0.14 (1.86)*	0.06
Volatility of stock market index, GARCH	−1.04 (−9.54)***	−0.15 (−2.25)**	0.08
Volatility of stock market index, rate of change	−1.02 (−8.74)***	−0.08 (−1.33)	0.02
Volatility of OECD industrial production, GARCH	−1.03 (−9.78)***	0.12 (1.76)*	0.08
Volatility of OECD industrial production, rate of change	−1.03 (−9.40)***	0.10 (1.65)	0.04
Volatility of budget deficits, GARCH	−1.07 (−9.92)***	−0.07 (−1.16)	0.02
Volatility of budget deficits, rate of change	−1.07 (−10.01)***	−0.10 (−2.09)**	0.03
Volatility of labour productivity, GARCH	−1.08 (−13.30)***	0.22 (3.54)**	0.26
Volatility of labour productivity, rate of change	−1.07 (−9.56)***	0.00 (0.02)	0.00
Volatility of oil price changes, GARCH	−1.03 (−8.62)***	0.07 (0.09)	0.01
Volatility of oil price changes, rate of change	−1.02 (−8.39)***	−0.03 (−0.37)	0.00
Volatility of real wages, GARCH	−1.00 (−9.68)***	0.19 (2.68)**	0.09
Volatility of real wages, rate of change	−1.02 (−9.24)***	0.16 (1.66)	0.09

t-values (calculated with robust standard errors using the method of Newey & West, 1987) in brackets. *** (**, *) denotes rejection of the null hypothesis at the 1% (5%, 10%) level.

We use quarterly seasonally adjusted data to calculate the volatility of the macroeconomic variables.[13] We calculate the volatilities based on two different concepts. First, we estimate a GARCH (1,1) model for each variable under investigation.[14] Second, we simply use the standard deviation of the variable during the year in which the forecast was made. We use all the variables described in the previous section. Thus, we estimate equations of the type:

$$\log\left(\sigma_t^{\mathrm{f}}\right) = \beta_0 + \beta_1 \sigma_{t-1}^{\mathrm{macro}} + u_t \qquad (3)$$

where σ_t^{f} is the standard deviation of the forecasts in a certain year and $\sigma_t^{\mathrm{macro}}$ is the volatility of the macroeconomic variables in the year when the forecasts were made.

The results presented in the Tables 6 and 7 show that the volatility of macroeconomic activity is positively correlated to forecast dispersion. In the case of growth forecasts, the volatility of short-term interest rates is most closely correlated to the degree of disagreement among forecasters. Obviously, the institutions share no common view on the impacts of interest rate changes on real activity.

So far, we have only looked at bivariate relationships between volatility and forecast dispersion. We next estimate a multiple regression to analyse whether all shocks together may explain forecast dispersion. However, in doing so, we have to take into account possible multicollinearity since we have several measures linked to one type of shock. Therefore, we use only one variable from each of the three types of shock. To represent each shock type, we selected the variable in each grouping that had the highest R^2 in the bivariate regressions (Tables 6 and 7). We then ran the regression:

$$\log\left(\sigma_t^{\mathrm{f}}\right) = \beta_0 + \beta_1 \sigma_{t-1}^{\mathrm{monetary}} + \beta_2 \sigma_{t-1}^{\mathrm{spending}} + \beta_3 \sigma_{t-1}^{\mathrm{supply}} + u_t. \qquad (4)$$

The results, presented in Table 8, indicate that the volatility measures jointly explain nearly 90% of the

[13] Details of the calculations are available upon request from the authors. The source for all data is OECD database for the economic outlook, as of September 2004.

[14] Details are available upon request from the authors.

Table 8
Forecast dispersion and macroeconomic volatility, multiple regressions 1971–2004

	Dispersion of growth forecasts	Dispersion of inflation forecasts
Constant	−0.81 (−12.38)***	−1.05 (−16.12)***
Volatility of short-term interest rates	0.18 (2.66)**	0.25 (3.49)***
Volatility of OECD industrial production	0.11 (2.44)**	−0.12 (−1.93)**
Volatility of labour productivity	0.08 (1.13)	0.18 (3.09)***
R^2	0.42	0.88
Test for normality (p-value)[a]	0.76	0.86
Test for autocorrelation up to order 2 (p-value)[b]	0.44	0.57
Test for heteroskedasticity (p-value)[c]	0.57	0.26

t-values (calculated with robust standard errors using the method of Newey & West, 1987) in brackets. ***, ** denotes rejection of the null hypothesis at the 1%, 5% level. (a) Jarque–Bera test for normality; (b) Breusch/Godfrey test for autocorrelation; (c) White test for heteroskedasticity.

dispersion of the inflation forecasts and somewhat less than 50% of the growth estimates.

With one exception, the coefficients have the expected sign and are significantly different from zero. Furthermore, standard tests point to well-behaved residuals.

4. Conclusions

We analyse 35 years of German business cycle forecasts by 14 different institutions that regularly make such predictions. We find that growth forecast dispersion varies over time and is particularly high before and during recessions. A similar relationship for inflation forecasts cannot be established. However, while there is dispersion among German forecasters, it is noteworthy that tests reveal that there is a consensus in most years, both for growth and inflation forecasts. The results also cast doubts as to whether forecast dispersion is a proxy for uncertainty, as it is sometimes considered in the related literature.

Forecast dispersion is correlated with the volatility of macroeconomic variables, but not necessarily with the level or the growth rates of the same variables. Since volatile macroeconomic variables are likely to reflect underlying shocks hitting the economy, a positive correlation between forecast dispersion and the volatility of macroeconomic variables indicates that the forecasters disagree on the relative importance of and the dynamic responses to shocks. We interpret this finding to be evidence in favour of the notion that forecasters do not share a common belief on the adequate model of the economy. In particular, the assessment of the effects of monetary policy seems to be the prime suspect for diverging beliefs regarding an appropriate model of the economy.

We leave several problems for future research. For example, it would be interesting to determine how forecasters revise their predictions when facing a particular shock. This might allow us to shed more light on other possible explanations for forecast dispersion, e.g., herd behaviour.

Acknowledgements

The authors thank two anonymous referees, the associate editor of this journal, Prof. Stekler, and Imke Brüggemann, Andreas Cors, Roland Döhrn, Felix Hüffner, Hans-Martin Krolzig, Thomas Knetsch, Udo Ludwig, Francis Piotrowski, Jürgen Wolters and Rudolf Zwiener, as well as seminar participants at the Institute for Statistics and Econometrics at the Free University Berlin for helpful comments on an earlier draft of this paper. We also thank Jan Gottschalk for providing us with the job of calculating a measure for monetary shocks and Birger Antholz for providing us with additional data and correcting some errors in our data set. The usual disclaimer applies. The views presented in this paper are the authors', and do not necessarily reflect those of the DIW Berlin or the Deutsche Bundesbank.

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