Monetary Policy Transparency:
Lessons from Germany and the Eurozone

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Abstract

The conduct of monetary policy emphasises institutional arrangements which make monetary policy decision-making more 'transparent'. Judged by these institutional features neither the Bundesbank, nor the ECB, score very highly. We test for (i) agents' average ability to anticipate policy rate changes under the Bundesbank and the ECB and (ii) and agents' forecasting unanimity of money market rates. Rising forecasting uncertainty may either be due to a lack of ECB transparency or to larger inflation and growth forecasting errors. Our results indicate that inflation forecast spreads widened amongst private agents and that inflation forecasting uncertainty increased the forecasting spread of money market rates.

Keywords: transparency, yield curve, forecasting uncertainty, Bundesbank, ECB

JEL code: E58

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1. Introduction

Since the late 1980s there has been a marked convergence in the conduct of monetary policy in developed economies. Broadly speaking, this has consisted of three phases. Firstly, in the 1980s, emerged a consensus that the policy instrument should be a short-term rate of interest rather than any direct or quantititative controls on the growth of money and credit. Secondly, roughly the 1990s, governments came to accept the arguments for credibility based upon the 'conservative central banker' and gave their central banks a considerable degree of independence in the conduct of monetary policy. More recently still, the argument that monetary policy outcomes are superior if policy-making is 'transparent' or 'open' has gained widespread support though, as we shall see, what makes for a 'transparent' policy process is not universally agreed.

Given the alleged benefits of transparency, it is natural that we should want to measure and rank policy-making regimes. Much of this work has followed the independence literature by listing a number of characteristics which *a priori* should make policy-making clear to observers and then checking these against the actual features of individual policy regimes. Judged in this way, neither the Bundesbank, nor its successor the ECB, score very highly and yet, interestingly, judged by outcomes, the Bundesbank's conduct of monetary policy from 1948 to 1999 was the envy of all developed economies.

In this paper, in section 3, we take a different, and we think more direct and relevant, approach to measuring the degree of transparency in monetary policy making. On this test, the Bundesbank's decisions appear to have been widely understood and expected. This is consistent with the general view of the Bundesbank as a successful central bank but undermines the argument that a specific set of institutional features are required as a pre-condition of transparency. Furthermore, we show that as far as German agents are concerned nothing has changed significantly with the introduction of the ECB, in spite of its alleged shortcomings in communicating its policy deliberations. This leads us to question whether the popular view that policy-making is more confused or obscure under the ECB may be based on circumstances which have nothing directly to do with transparency itself.

In section 4 we look at the possibility that agents have become more uncertain about monetary policy decisions in recent years. The logic of this is that although (in section 3) we see

that agents are well-able to anticipate interest rate decisions *on average*, this might conceal a widening dispersion of views about what the next move is likely to be. In the circumstances, agents will report themselves as 'less certain' (and blame the ECB). We think that there is some evidence that agents have become more uncertain about monetary policy moves under the ECB.

Another possibility is that there has been an increase in the general level of macroeconomic uncertainty during the period. If agents find it harder to predict the course of variables which enter into what they take to be the central bank's decision rule, then this will show in a widening dispersion of views about future interest rates and an increase in the proportion of agents reporting that uncertainty. In section 5 we find that uncertainty about the future course of inflation does seem to have increased while evidence for the other key variable, GDP, is mixed. We also find that there is some evidence that inflation uncertainty increases agents' uncertainty concerning money market rates. The implication is that it is not only the alleged opacity of ECB policy that has increased agents' uncertainty, but short-term interest rate uncertainty is affected by uncertainty about future inflation.

But the first step, in section 2, is to look (as briefly as we can) at why transparency is expected to produce superior monetary policy outcomes. (These arguments will justify our approach to measuring transparency in section 3). We shall also look at how the Bundesbank features in the existing transparency literature.

2. Transparency and the Bundesbank

One line of argument for the benefits of transparency, links it to credibility. In so far as being open about the inflation target and operating methods makes it easier for agents to hold the central bank to account, central banks have more incentive to deliver. With greater credibility, the sacrifice ratio is reduced. This is the basis of the paper by Chortareas *et al.,* 2003. A second argument is that transparency reduces noise and the possibility for error in private sector decision making. Important here is that private sector agents understand the model of the economy with which the policy-makers are operating. This helps anchor the public's expectations about future policy moves (Bean, 1998 p.1796) and is the main argument behind the Bank of England's ambition to make monetary policy 'boring' (King, 1997, p.440). If agents understand how the central bank's mind works, then they can anticipate the next policy move, as though they were making policy for themselves. In these circumstances, the 'news' is in current economic developments and not in any subsequent interest rate change that the central bank might initiate in response. If this can be achieved, then monetary policy actions themselves no longer risk adding to the noise and general instability in the economy. A third argument follows from the breakdown of the policy ineffectiveness proposition.

This is that monetary policy actions do have an effect upon the real economy but that the transmission mechanism often involves medium or long-term interest rates, while the policy instrument is invariably a very short-term rate. What links the two is often said to be 'expectations' and from this it is argued that agents' expectations are more likely to be correct if they fully understand the thinking behind the authorities' actions. If all this is true, then policy transparency enhances the effectiveness of stabilisation policy. (Blinder *et al.,* 2001; De Haan and Amtenbrink, 2002; Woodford, 2001; Freedman, 2002).

Attempts to measure the degree of monetary policy transparency have taken three broad forms. The first, very reminiscent of the central bank independence literature (e.g. Alesina and Summers, 1993), might be called the 'characteristics approach' since it lists the characteristics which seem necessary *a priori* for transparency (in all its dimensions) and then checks them against individual policy regimes. Such characteristics include:

- a fixed schedule of policy decision dates;
- the publication of the minutes of the meeting at which the decision is taken;
- publication of the voting record (where a committee is involved);
- a quantified inflation target;
- publication of the macroeconomic data underlying the decision;
- and an explanation of the macromodel used by the policy-makers.

A second approach is to use survey evidence. Since money market traders have a powerful commercial incentive to anticipate central bank interest rate changes, it seems reasonable to assume that such agents will be particularly well-informed as to the principles guiding central bank decision-making and will hold strong views on how easy it is to understand those principles.

Thirdly, some studies have looked at the *behaviour* rather than the opinion of professional traders to see what this reveals about their ability to understand central bank thinking. Although there are many ways of doing the empirical tests, the central logic is to look at the extent to which market rates (determined by traders) anticipate the subsequent decision of central banks regarding the official rate. This is the ultimate and most direct test of the King ambition that the 'news' should be in the macroeconomic news and not in the central bank's decision.

It also addresses Daniel Thornton's (2003) reservations about the tendency to pursue transparency as an end in itself. Thornton issues a number of cautions. Prime amongst these is the argument that economists should view transparency as beneficial only if it enhances monetary policy outcomes and the possibilities for this are dependent upon the objectives of policy. If, for example, stabilisation were a major objective of monetary policy, then secrecy and surprise would more likely be outcome-enhancing than transparency. Transparency can only be relevant if price

stability is the paramount objective. Even then, it is not clear that transparency is a *necessary* condition for success. 'For years, the Swiss National Bank and the Bundesbank had credibility for keeping inflation low and steady. This occurred despite the fact that neither central bank was a model of transparency'. (Thornton, 2003, 485). If the principal objective of policy is price stability, then the ability of agents to understand and anticipate central bank decisions is one aspect of transparency that should be helpful.

Table 1 shows the rankings of a range of central banks as determined by a variety of the 'characteristics' studies and by two surveys.

Table 1: Central bank transparency - rankings by study

	Fry *et al* (2000)	Eijffinger & Geraats (2002)	De Haan & Amtenbrink (2002)	Bini-Smaghi & Gros (2000)	Goldman Sachs* (2000)	Waller and De Haan* (2004)
Australia	15=	7=	-	-	-	-
Canada	13=	4	3	-	-	-
D Bundesbank	25=	-	6	5	2	5
Eurozone	-	5=	4	2	4	6
France	40=	-	-	-	-	4
Italy	12	-	-	-	-	1
Japan	5	7=	-	-	-	3
New Zealand	4	1	1	4	-	-
Sweden	1=	3	-	-	-	-
Switzerland	8=	9	-	-	-	-
UK	3	2	2	1	3	2
US	1=	5=	5	3	1	7

Sources: see text. Note: * = survey of market opinion

Some caution is needed in interpreting the results since the studies vary considerably in size and range. But it is apparent that, *within each study* in which it appears, the Bundesbank comes low in the rankings (except for the Goldman Sachs survey) and the ECB ('Eurozone') comes low in the rankings (except for the survey by Gros and Bini-Smaghi). The low ranking of the ECB is echoed, of course, in the debate between Buiter (1999) and Issing (1999) where the former laments the ECB decision not to publish minutes or voting records of meetings, or an inflation report.

As we said above, the third approach, focusing upon the behaviour of short-term market interest rates, offers a more direct test of transparency particularly if we see transparency as

meaning the ability of agents to anticipate central bank decisions. Examples of this approach include Kuttner (2001) and Poole, Rasche and Thornton (2002) who have all documented the ability of US money markets to anticipate monetary policy change., the latter showing that anticipation has improved since the Federal Reserve began announcing its target for the Federal Funds rate in 1994.

The remarkable feature of those studies which shed light on anticipation in the case of the Bundesbank and the ECB, however, bearing in mind variations in data, time periods and methodologies, is the extent of their agreement that agents understand the Bundesbank/ECB decision-making process at least as well as they do in regimes noted (in the other evidence) for their transparency. Typical is the paper by Perez-Quiros and Sicilia (2002) which makes explicit comparison between the ECB and the Federal Reserve and finds '…that markets do not fully predict the ECB decisions but the lack of perfect predictability is comparable with the results found for the United States Federal Reserve.' (2002, p.4). In their study of Norway's central bank, Bernhardsen and Kloster (2002) found that market anticipation of policy was inferior to that of the Eurozone, but that the latter was higher than in the UK and USA. Coppell and Connolly (2003), looked at market anticipation in Australia using a methodology similar to that of Haldane and Read, 2000 (see below) and compared it with other regimes including the USA, UK, Canada and Germany. The data covered the period 1996 to 2002 and thus for Germany covered a period of both Bundesbank and ECB policy-making. They found '…it [was] not possible to reject the hypothesis that the level of anticipation by the markets of a rate move in each country [was] equal'. Daniel Hardy's (1998) study for the IMF rather pre-dates the interest in transparency and is a rather oblique test of anticipation. It focused directly on the Bundesbank, without comparisons, but nonetheless shows evidence of German money markets having little difficulty in anticipating Bundesbank interest rate decisions. Ross (2002) is another IMF study, this time of the ECB after three years of operation. This too makes comparisons with the Federal Reserve and the Bank of England and concludes 'That all three central banks are relatively predictable institutions with a high degree of credibility'. The study did though find that markets have had some difficulty in anticipating large changes and especially cuts in ECB rates.

The study by Haldane and Read (2000) is particularly interesting partly because it decomposes monetary 'surprises' into news about policy variables and news about policy preferences but also because its approach has been taken up by other researchers like Coppell and Connolly (above) and is used in the empirical section of this paper. Its immediate relevance here is that it compared the response to surprises of the yield curve in the UK, USA, Italy and Germany. News about policy variables shows up in movements at the short end of the yield curve and is evidence of imperfect transparency. The sample period is March 1984 to January 1997 (so for Germany it covers only the Bundesbank regime). The results are worth quoting at some length.

> Looking first at surprises at the short end … these are significantly larger in the UK and Italy than in the United States and Germany. For example, in Italy the percentage surprise is between 40-80% at the short end, while in the UK it is between 30-60%. This compares with between 5-15% in the United States and Germany, pointing towards a much better defined reaction function in the latter two countries. *This seems intuitively plausible.* (Haldane and Read, 2000 p.29. Our emphasis).

In a three-way comparative study of the degree of anticipation and speed of adjustment of market rates to official rates using a GARCH model, we ourselves found that agents seemed best able to anticipate the decisions of the Bank of England, though the Bundesbank's also contained little surprise. (Biefang and Howells, 2004a). Agents had more problems with the ECB. In particular, like Ross (2002) we found that they were often surprised by cuts in the ECB rate, a fact we attributed to the ECB being a relatively new institution and to very few instances of interest rate reductions from which markets could learn. (See also *Financial Times,* 11.5.01).

So, there is something strange here. On the basis of visible operating procedures, the Bundesbank and the ECB score relatively low on the transparency index. And yet the Bundesbank by reputation was the model of a successful central bank. Furthermore, tests of agents' ability to understand and anticipate central bank policy actions (the test that matters) both perform relatively well. In the rest of this paper we go on to consider whether there may be other factors at work, giving the Bundesbank and the ECB an unwarranted reputation for opacity, when in reality agents have little difficulty in following the signals. The first step, in the next section, is to update agents' responses to Bundesbank/ECB decisions to check firstly the degree of anticipation and to see whether this anticipation changes when policy is taken over by the ECB.

3. Policy anticipation

Agents do not have perfect knowledge of future central bank actions. There is uncertainty about the path of future macro variables and, in the absence of a published Taylor-rule or similar, uncertainty about the central bank's reaction function. Thus the conventional view is that depending on the degree of central bank transparency, some amount of surprise will remain, which will cause a jump in the yield curve on the day of announcement. The size of the jump may be a measure of central bank opacity.

We use daily data for Germany from January 1989 until 21st July 2004. The market interest rates are the daily rates in Frankfurt for 1, 3, 6, and 12 months. This gave us about 3890 observations on each maturity. During this period, the Bundesbank changed the discount rate 22

times over 10 years and the ECB changed its policy rate in the last five and a half years 15 times. The median of the policy rate changes by the Bundesbank is 50 basis points, while the ECB median is 25 basis points. The Bundesbank only had one sign change, while the policy rate of the ECB changed sign twice.

In this section, we are interested in two questions, namely (i) what is the size of the average policy rate surprise over the whole sample period and (ii), has policy surprise altered since the ECB took over the conduct of monetary policy from the Bundesbank. To extract some measure of policy surprise and its potential change along the yield curve, we estimate the change in the market interest rate as follows (Haldane and Read, 2000):

$$\Delta mar_{t,j} = c_j + \beta_j(L)\Delta mar_{t,j} + \lambda_j \Delta pol_t + \delta_j D99\Delta pol_t + e_t \quad (1)$$

The subscript *j* stands for the term to maturity. The variable *mar* indicates the market rate, *pol* stands for the official rate and *D99* is an impulse dummy with the value 1 from January 1999 onwards and zero otherwise.

Lags of the dependent variable were included to reduce serial correlation. The coefficient λ measures the average interest rate surprise over the full sample. If λ=0, the market rate does not change in response to the change in the official rate and policy was fully anticipated before the central bank changed the official rate. In other words, central bank policy itself is no news. Since the central bank is expected to change the policy rate in response to the change in the macro economic variables, market rates adjust in response to macroeconomic news, only and *before* the central bank changes the policy rate. Similarly, if λ=1, market agents are completely taken by surprise by central bank policy with all adjustment taking place on the day of announcement.

The coefficient δ measures the effect on mean interest rate surprises due to the regime shift from Bundesbank to ECB. If δ=0, then there is no change in interest rate surprises due to the regime shift. If, as the financial press has suggested on various occasions, changes in the ECB policy rate are unexpected, then the sign of the coefficient δ should be positive. The sum of the coefficients λ and δ measures the size of the average interest rate surprise along the yield curve during the later period of ECB policy.

Table 1 below shows the results of equation (1). The model was estimated with OLS. Since all equations have significant levels of serial correlation, the t-values in brackets in Table 1 are calculated on the basis of Newey-West adjusted standard errors to ensure consistency.[1]

[1] The results of the Lagrange Multiplier test are not reported here, but will be provided by the authors on request.

Table 1: The policy surprise in short-term interest rates in Germany

$Rate_j$	c	$\beta_{j,1}$	$\beta_{j,2}$	$\beta_{j,3}$	λ_j	δ_j	R^2
1 Month	-0.001	0.123	0.045	-0.012	0.094	0.128	0.05
	(0.94)	(4.16)	(1.13)	(0.72)	(2.32)	(1.35)	
3 Months	-0.001	0.185	0.062	0.027	0.077	0.103	0.08
	(1.17)	(6.46)	(2.45)	(1.02)	(2.10)	(1.25)	
6 Months	-0.001	0.224	0.062	0.033	0.066	0.086	0.10
	(1.25)	(7.58)	(2.53)	(1.10)	(2.47)	(1.37)	
12 Months	-0.001	0.207	0.030	0.029	0.058	0.089	0.07
	(1.13)	(8.64)	(1.45)	(1.07)	(2.24)	(1.46)	

Turning first to R^2, we note that between 5 and 10 per cent of the average variation in the market rate is explained by the model. The policy surprise coefficient λ is significant throughout the yield curve. Taking the sample period as a whole, between about 9 and 6 per cent of a policy rate change comes as a surprise on the day of the announcement. These results indicate that the information advantage of the central bank on macroeconomic development over private agents is quite low.[2] The coefficient of the dummy variable is positive, although insignificant along the yield curve. Crucially, we do not find statistical evidence for the hypothesis that ECB interest rate decisions contain a greater surprise element than the former Bundesbank's.

4. Interest rate uncertainty

In the previous section we found that on average, agents' ability to anticipate central bank monetary policy has not changed since the regime shift and, that on average, anticipation is actually quite high during both regimes. In this section, we look at central bank policy anticipation from a different angle. We now look at the degree of unanimity with which private agents anticipate interest rate changes by the central bank. In other words, we test whether the cross-sectional distribution of forecasting has changed. It may very well be that anticipation and implicitly policy forecasting has not changed on average; however, the forecast spread of private forecasters may have altered. This effect would not show up in the estimations of the previous section.

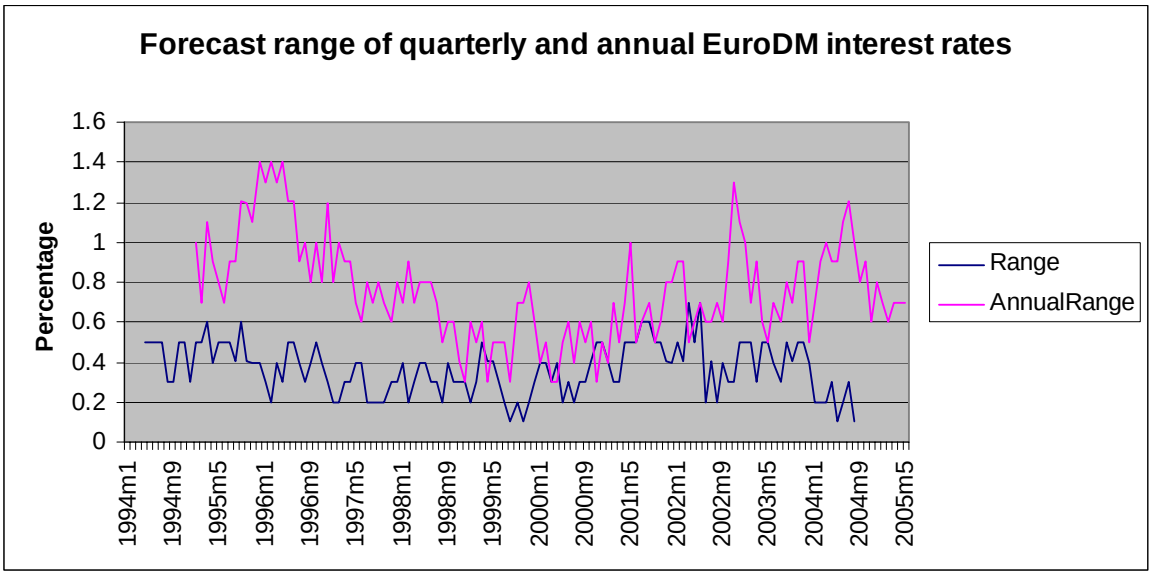
If the distribution of cross-sectional dispersion has shifted since the ECB conducts monetary policy, in that the range of forecasts has become wider, then this fall in private agents' unanimity indicates that private agents have become more uncertain about the conduct of monetary policy.

[2] This compares with similar coefficients for the Bank of England since the introduction of inflation targeting (Biefang-Frisancho Mariscal and Howells, 2004b)

Next, we turn to the measurement of consensus across agents' forecasts and then we test whether there has been a change in it.

For measurement purposes, we looked at the range of forecasts of private institutions as reported in *Consensus Forecasts*. Every month, this publication shows the forecasts for, *inter alia,* the 3-month euro-DM interest rate for some 25 private sector institutions (although this number of institutions reporting forecasts varies somewhat during the year). The forecasts are for 3 and 12 months ahead. We calculated the range for the third highest and third lowest forecasts (which is about the 12th and 88th percentile of the distribution) and compared it over time. Any changes in the cross-sectional distribution of forecasts are interpreted as a change in the conformity with which individual private agents forecast central bank policy. The figure below shows the annual (AnnualRange) and quarterly (Range) forecast range of the 3-month Euro-DM rate.

Figure 1: Range of quarterly and annual forecasts of 3-month euro-DM rates



The quarterly forecast range varies most of the time between 0.2 and 0.6 percentage points. Between the two periods, 1994 and 1995 and 2001 and the beginning of 2002, the range is wider and falls thereafter. In 2000/01, the ECB was a new institution, which may be reflected in the initially widening and then declining forecasting spread of the money market rate. From the 3rd quarter 2002 onwards, the quarterly forecast range falls to and below its previous conventional level. The one-year ahead forecast range has a more varied pattern. The forecast range peaked for the beginning of 1996 to 1.4 percentage points indicating that agents' forecast uncertainty concerning interest rate predictions for 1996 was high. Agents' uncertainty fell steeply from then

onwards to about 0.6 percentage points between mid 1998 and end 2000. This degree of consensus fell from 2001 onwards, where a positive trend seems to show up.

In order to test whether there was a significant change over time in agents' degree of uncertainty and whether uncertainty changed significantly since the introduction of ECB policy, we estimated the following model:

$$Range_{t,i} = \alpha_i + \gamma_i D99 + \beta_i Trend + \delta_i D99Trend + e_t \qquad (2)$$

The subscript *i* distinguishes between the quarterly and one-year ahead forecast range of the euro-DM rate. The dummy variable *D99* has the value 1 from January 1999 onwards and is zero otherwise. The variable *Trend* is a time trend. The coefficient γ measures the shift in the degree of uncertainty since 1999. If γ=0, then the level of uncertainty has not changed since the regime change to ECB monetary policy. A positive coefficient γ indicates an increase in the forecasting range of private agents. The coefficient β measures the development of agents' uncertainty over time over the entire sample period. A negative β-coefficient indicates increasing forecasting consensus of the private institutions reported in *Consensus Forecasts.* The coefficient δ measures the change in degree of uncertainty over time since the institutional change. The sum of the coefficients β and δ measures the degree of agents' uncertainty over time during ECB policy. The table below shows the empirical results:

Table 2: Quarterly and annual forecasting range of the 3-month euro-DM rates

Variable	α_i	γ_i	β_i	δ_i	R^2
Range	0.490	-0.171	-0.004	0.004	0.12
	(17.54)	(1.22)	(5.11)	(2.63)	
annualRange	1.161	-0.941	-0.012	0.017	0.45
	(8.78)	(5.69)	(2.96)	(4.12)	

Note: All equations are estimated by OLS and the t-values in brackets are calculated on the basis of Newy-West adjusted variances and covariances.

Firstly, we turn to the results of the estimation of the quarterly forecast range (Range). We find that 12% of the variation of the mean forecast range is explained by the model. Over the whole sample period, mean forecasting uncertainty declines by 0.004 percentage points per month. Since the ECB has taken over monetary policy, the downward trend in forecasting uncertainty has been reversed. For the later period alone, there is no (upward or downward) trend in the average forecasting range. The shift dummy is insignificant, so that for the ECB period, the average

forecasting range (the difference between the third highest and third lowest euro-DM interest rate forecast) is not different from the overall sample range of 0.49 percentage points.

The R^2 in the second equation of Table 2 shows that 45% of the average variation in the one-year-ahead forecast range of the 3-month euro-DM rate is explained by the model. All coefficients are significant. Over the sample period, the average forecasting range declines by 0.012 percentage points per year. This trend has been reversed since ECB policy was introduced. During the ECB regime, monetary uncertainty has been rising on average over time by 0.005 percentage points. As can already be seen in figure 1, the average forecasting range was high during the Bundesbank regime and declined thereafter. The average forecasting range has fallen significantly since ECB's monetary policy regime. During the later sample period, the average forecasting range is about 0.3 percentage points, which compares with about 1.2 percentage points during the Bundesbank regime.

These results suggest that uncertainty regarding the 3-month euro-DM rate has risen since the ECB conducts monetary policy. However, the result is not so unambiguous for the one-year ahead forecasting range of the euro-DM interest rate. There we found that the downward trend has reversed to an upward trend in uncertainty since ECB policy, but also, that there has been a strong downward shift in the average forecasting range. Considering the results of the one-year ahead forecasting range, we cannot generalise that ECB policy has increased agents' uncertainty. Also, it may not be ECB's ad-hoc policy or lack of transparency which is responsible for the reported increase in uncertainty. We turn to this issue in the section below.

5. Macroeconomic uncertainty

In this section, we are concerned with the question for why agents have become more uncertain about forecasting the money market rate. The underlying hypothesis is, of course, that this is due to the way in which the ECB conducts monetary policy relative to the former Bundesbank. However, since agents are assumed to 'guess' on the basis of a 'policy rule' which itself relates the official rate to macroeconomic indicators, uncertainty does not only arise about the coefficients in this relationship, but also about the terms relating to the coefficients. In other words, even if the central bank reaction function is well understood and known, it is possible that agents find it difficult to forecast relevant macroeconomic variables. If this is the case, then even for given and 'known' coefficients in the reaction function, the forecasting range of money market rates varies with the forecasting range of, let us say, the inflation rate. The uncertainty about future inflation (or economic growth), will then show up in a greater spread of the forecasts of money market rates.

Agents may become more uncertain about macroeconomic development, either because the economy moves away from a more stable state, or there is a turn in the business cycle, or the

economy experiences shocks, to give just a few examples. Also the establishment of new, major institutions may initially cause greater uncertainty for agents until these institutions have been established for some years or so.

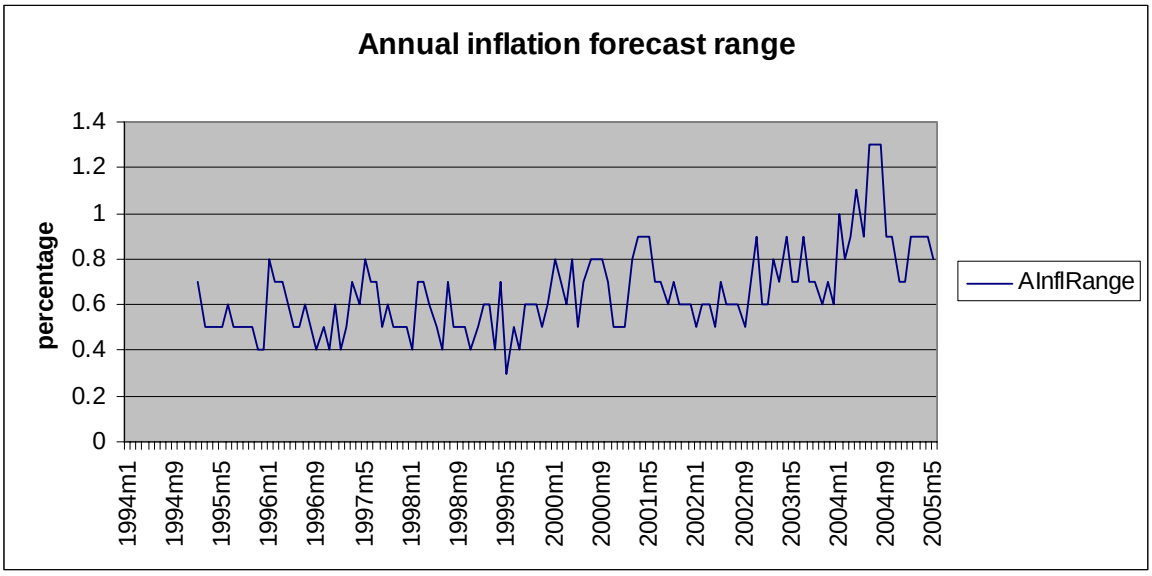
EMU is a new phenomenon and in this section we want to analyse whether agents found it more difficult in these circumstances to predict macroeconomic variables as inflation and GDP growth. Particularly at the beginning of the EMU, it may be more difficult for agents to predict the macroeconomy of individual countries in the 'new' area given the uncertainty over the true degree of convergence of individual economies and how they would react to the 'one-size-fits-all' level of interest rates. Since the prediction of central bank policy moves depends to some extent on agents being able to forecast movements in the variables entering the bank's reaction function, then increasing difficulty in forecasting these variables would make agents less confident in their anticipation of policy moves.

The official interest rate is set by the central bank according to a monetary policy rule that describes how interest rate decisions link to the state of the economy, as inflation, output, employment etc. Given this rule, agents will tend to form their guesses about future policy rates not only on their knowledge and understanding of the central bank policy rule, but also on their ability to predict the terms in the policy rule, as inflation, output etc. If forecasting uncertainty of relevant macroeconomic variables has changed, this change must, via the central bank policy rule, affect agents' degree of monetary policy uncertainty.

Firstly, we will look at how agents' uncertainty regarding inflation and GDP growth in Germany has developed over time. Secondly, we will test whether macroeconomic forecasting uncertainty has affected interest rate uncertainty.

We turn to the analysis of agents' degree of uncertainty with respect to inflation and real GDP growth. As before, we use the forecasting range, calculated as the difference between the fourth highest and fourth lowest forecasting value. We have monthly data for inflation and real GDP growth, each predicted one year ahead. The sample period for the inflation forecast range is from January 1995 until May 2005 and for the GDP growth range it is from June 1995 until May 2005. Forecasts for GDP growth refer to unified Germany throughout. Inflation forecasts are reported for West Germany until September 1997, only. Figures 2 and 3 below show the one-year-ahead inflation and GDP growth forecast range, respectively.

Figure 2: The one-year-ahead inflation forecast range

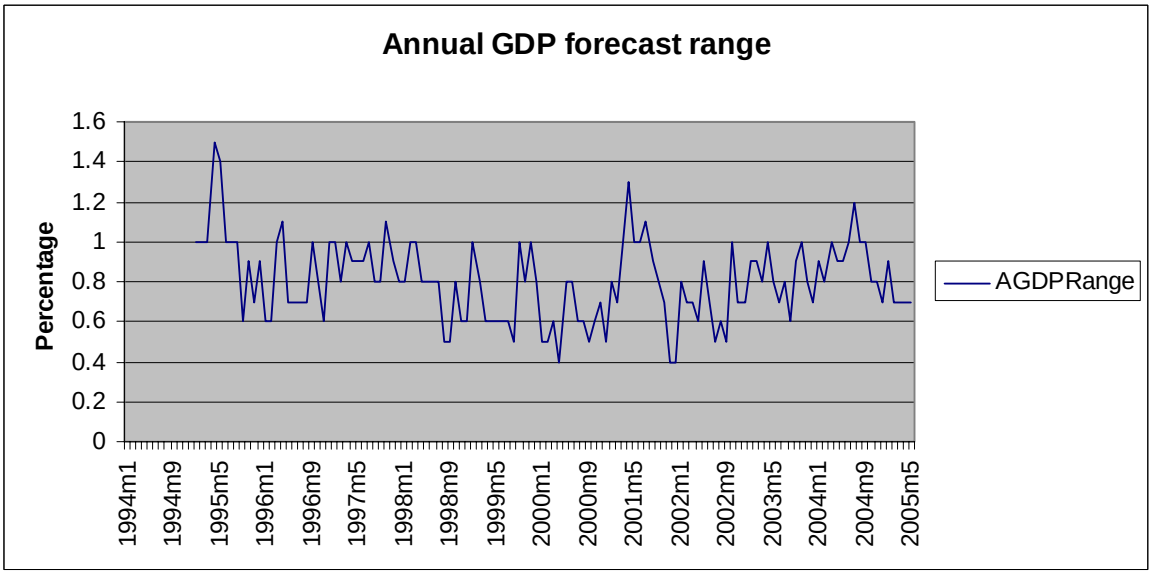


Note: calculated as the difference between the third upper and third lower forecast

Figure 2 shows that the forecasting range of the inflation rate varies between 0.4 and 0.8 percentage points until the end of 2000. After that period, an upward trend is discernible, with a generally higher level of the forecasting range.

Turning to Figure 3, uncertainty concerning forecasts of GDP growth is higher than inflation uncertainty. This is particularly so until mid 1998. From then onwards, there is a fall in the level of the forecasting range and later in the sample period, a slight upward trend.

Figure 3: The one-year-ahead real GDP growth forecast range



Note: calculated as the difference between the fourth upper and fourth lower forecast.

The estimation results depicted in Table 3, confirm these observations. We used equation (2) above, where now the dependent variables changed to the one-year-ahead inflation and one-year-ahead real GDP growth forecasting range. Also, the dummy has now the value 1 from 2000 onwards and zero otherwise.[3] We included a further dummy to account for a change in the reporting of the inflation data from West Germany to Germany. It was insignificant and not reported here.

Table 3: Annual forecasting range of the inflation rate and GDP growth.

Variable	α_i	γ_i	β_i	δ_i	R^2
InflationRange	0.553 (18.09)	-0.215 (1.45)	-0.0002 (0.40)	0.005 (2.62)	0.42
GDPRange	0.895 (16.86)	-0.435 (2.33)	-0.003 (1.66)	0.006 (2.58)	0.10

Note: All equations are estimated by OLS and the t-values in brackets are calculated on the basis of Newy-West adjusted variances and covariances.

We firstly turn to the discussion of the inflation range. Over the entire sample period, the average inflation forecasting range was about 0.55 percentage points in Germany. Since the ECB regime, there is no change in the mean level of the forecasting range. However, we notice that while over the entire sample period there is no discernible trend in the mean forecasting range, the later period shows that average inflation uncertainty has steadily risen by 0.005 percentage points per month. The estimation results for GDP uncertainty confirm those of Figure 3. The average forecasting range for real GDP growth was rather high at the beginning of the sample period and fell dramatically since 2000. While there is no trend behaviour over the entire sample period, we find, as for the inflation range, that uncertainty is rising steadily since the ECB regime.

While the change in GDP uncertainty is not unambiguous from 2000 onwards, inflation uncertainty obviously has risen in the more recent period. As we discussed above, this rise in inflation uncertainty may account for some of the increase in money market rate uncertainty. In the following section, we want to test whether this is actually the case.

We modified equation (2) above and only added the one-year-ahead inflation range. We only estimated equation (2) for the one-year-ahead forecast range of the euro-DM rate since we do not have inflation data that are forecast monthly or three-month-ahead. The estimation result is:

[3] Agents forecast GDP growth and inflation in 1998 for 1999, in 1999 for 2000 etc. In 1998, when the forecast was made for 1999, the ECB was not yet established.

$$AnnualRange = 1.025 - 0.877 D99 - 0.012 Trend + 0.016 D99Trend + 0.248 AInflRange$$
$$(7.20) \quad (5.45) \qquad (3.03) \qquad (3.94) \qquad (1.79)$$
$$R^2 = 0.47 \qquad LM(10) = 36.05$$

The variables and diagnostics are defined as before, with *AInflRange* as the one-year-ahead inflation range. The values in brackets are t-statistics. We used OLS and the variances and covariances are Newey-West adjusted. The coefficients have not changed very much from those for the annual euor-DM interest rates as reported in Table 2. Inflation uncertainty increases the mean forecasting range of the euro-DM rates by 0.25 percentage points. However, this coefficient is only significant at the 8% level and should therefore to be interpreted cautiously.

6. Conclusion

We addressed the question of Bundesbank and ECB policy anticipation from two angles. Firstly, we estimated the average size of policy surprise during the Bundesbank and the ECB regime, respectively. We found that during both regimes, money markets anticipated policy changes well. In comparison to other studies and our own, we found that the mean degree of anticipation for Bundesbank and ECB was as good as for the BoE during its inflation targeting period (see also Biefang-Frisancho Mariscal and Howells, 2004b). Further, there was no break in the coefficients when the regime changed from Bundesbank to ECB. This part of the anticipation analysis has been concerned with the *average* degree of anticipation and implies that on average, agents forecasted movements in the official rate, well.

Secondly, still concerned with the question of policy anticipation, we turn our attention to the cross-sectional spread of private sector policy anticipation. It is possible, that mean anticipation has not changed during the two regimes, but that there has been a widening of the cross-sectional dispersion in policy anticipation. We interpret the widening of this spread as an increase in agents' uncertainty about the conduct of central bank policy. We measure the degree of cross sectional dispersion by calculating the difference between the third highest (about 90th percentile) and the third lowest (about 10th percentile) private agent forecast for the euro-DM money market rates. When we test formally, we find clear indication that the 3-month ahead forecasting dispersion for the 3-month euro-DM rate has risen since the ECB conducts monetary policy. Is this rise solely due to ECB's opaque policy, or do other factors play a role?

In answer to this question, we find that private agents have become more uncertain about forecasting inflation. Inflation uncertainty has grown gradually since ECB conducts monetary policy. The result on GDP growth uncertainty is more ambiguous.

In the last section of the empirical analysis, we test whether the rise in private agents' inflation forecasting uncertainty has affected the dispersion of money market rates. We find some evidence that that is so.

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