Monetary Policy Transparency and Uncertainty: A Comparison between the Bank of England and the Bundesbank/ECB

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Abstract

It is widely believed that institutional arrangements influence the quality of monetary policy outcomes. Judged on its 'transparency' characteristics, therefore the Bank of England should do better than the Bundesbank/ECB. We show that this is not confirmed by agents' ability to anticipate central bank decisions. Furthermore, benefits from transparency should also show in a narrowing of the diversity in cross sectional forecasts. We show that the diversity in interest rate forecasts is no greater under the Bundesbank/ECB than the Bank of England. This suggests that other factors than 'transparency' may affect interest rate uncertainty. Increasing difficulty in forecasting inflation appears to play a part in the UK while being less of a problem in Germany.

Keywords: transparency, yield curve, forecasting uncertainty, Bank of England, Bundesbank/ ECB

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1. Introduction

It is now widely accepted that 'transparency' in the conduct of monetary policy improves policy outcomes.[1] The reasons for this have been widely explored (see e.g. Chortareas, *et al,* 2003) and it is clear that the range of benefits is partly due to the range of meanings which can be given to the term (Geraats, 2000). For the purposes of this paper, the evidence of transparency with which we are concerned (a) defines a transparent policy as one where agents can anticipate CB decisions and thus (b) sees the advantage primarily in preventing policy decisions themselves being a source of destabilising shocks to the economy. This is essentially the position taken by the Bank of England and lay behind Mervyn King's (1997) famous remark that the hallmark of a well-conducted monetary policy is that it should be 'boring'. The 'news' should be in the behaviour of macroeconomic variables and not in the central bank's subsequent reaction to them. Notice that this amounts to an ambition whereby agents will know the (a) the structure of the central bank's reaction function, (b) the size of the coefficients, (c) the value of the macro-variables to which these coefficients apply and therefore (d) the way in which those macro-variables are likely to be influenced by any change in the official rate of interest.

The first publication to confirm the importance placed by central banks on the transparency of their actions was the study by Fry *et al.* (2000) which showed that some 74 per cent of banks claimed to promote the openness of their policy making. Since then, there have been numerous studies which attempt to measure the actual (or perceived) transparency of individual regimes. Such studies fall into three broad categories. Firstly, there are those which, following the central bank independence literature of some fifteen years ago, rank central banks according to their demonstration of institutional characteristics deemed *a priori* to contribute to

[1] But see Thornton (2003) for some critical observations.

transparency (for example, Fry *et al*, 2000; Eijffinger and Geraats, 2002; De Haan and Amtenbrink, 2002). Secondly, there are surveys of market opinion (for example, Goldman Sachs (2000), Waller and De Haan (2004) and Reuters (recurrently)). Thirdly, there are tests of practitioners' ability to anticipate the decision of the policymaker. These focus upon movements in short-term money market rates surrounding the date of an interest rate decision and we turn to these in a moment.

What is apparent from the 'characteristics' and the survey evidence is that the ECB does not rank consistently highly, in spite of its constitution being drawn up in a period when transparency was at least beginning to become fashionable. Also apparent, but less surprising, is that its predecessor, the Deutsche Bundesbank generally ranks low in the league tables. The position of the ECB in these rankings tends if anything to confirm the allegations made by Buiter in the famous Buiter-Issing (1999) debate that the absence of an inflation report and minutes or voting records of meetings was unhelpful to agents.

What is even more surprising than the moderate ranking of the ECB is the fact that *both* the ECB and the Bundesbank score highly in the third group of studies, based on what we shall call market-evidence. Relevant studies here include Bernhardsen and Kloster (2002); Coppell and Connolly (2003); Haldane and Read (2000); Hardy (1998); Perez-Quiros and Sicilia (2002) Ross (2002) and Wadhwani (2001). These are invariably comparative studies and (although countries in the comparisons vary) what generally emerges is that money market practitioners find it no more difficult to anticipate the interest rate decisions of the Bundesbank or later the ECB than they do, say, the actions of the Bank of England or the Federal Reserve. Writing in the *Bank of England Quarterly Bulletin* in 2001, Wadwhani reported that 'The results of this exercise [covering the period 1997-2001] suggest that the average market 'surprise' on the day of an interest rate decision has been higher in the UK compared with the United States and Europe' (Wadwhani, 2001, p.355). Coppell and Connolly (2003) looked at market anticipation in Australia 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'.

It is perhaps not altogether surprising that the results from the 'characteristics' approach and from market interest rates should differ. Listing rather arbitrary characteristics and attaching (even more) arbitrary weights to them received a critical press at the time of the independence investigations and the results deserve to be treated with caution. What is more remarkable is that the practitioners whose actions in money markets appear to confirm that they can ‘read’ the ECB and (could read the) Bundesbank tolerably well, are substantially the same agents who report themselves as uncertain or confused by the ECB and Bundesbank behaviour in the surveys. In this paper we try to shed some light on this apparent paradox.

We do this by making use of additional information provided in cross sectional data, which allow us to examine the dispersion of views amongst agents when they predict future relevant variables.[2] As Haldane and Read (2000) and other authors have shown (and we show for the ECB), *on average* agents anticipate Bank of England policy no better than Bundesbank or ECB policy. However, transparency should not only reduce the size of average policy surprises, but greater benefits from transparency should also be apparent in a narrowing of the diversity in cross sectional forecasts. This paper is concerned with answering the following questions: (i) Has the spread of market rate forecasts changed over time and does it vary under different regimes? If transparency reduces uncertainty, then we would expect a greater decline in the dispersion of forecasts under the Bank of England than under the ECB regime. (ii) Has the forecast spread of key macro variables changed in Germany and the UK and if so has it changed in different directions? The dispersion across forecasts may have changed because the economy is more stable and thus easier to forecast. For example, since macroeconomic forecasts enter the reaction function of the central bank, an increased convergence of view about the future path of interest rates may be due more to greater certainty about future economic developments than to greater transparency. (iii) Is the change in forecast diversity an important variable in explaining the dispersion of forecasts regarding money market developments?

Since our starting point in this study is the observation that agents *behaviour* in money markets is at odds with their reported *perceptions* in surveys and with what one might expect from regime characteristics, it seems appropriate bring the market evidence up to date, in section 2, using the Haldane and Read (2000) model referred to above. We shall see that this confirms that nothing much has changed in UK and German money markets since their investigation. Agents are still able to ‘read’ German money markets pretty well.

In section 3, we test the hypothesis that while agents anticipations *in aggregate* may be broadly correct, underlying this ‘average’ outcome there may have been an increasing dispersion of individual views about the next movement in interest rates. In section 4 we look at why this might be the case, by looking at agents’ views about the two key variables in the central bank’s

[2] The only other study we are aware of which also uses cross-sectional data to analyse the potential benefits of transparency is Swanson (2004) for the USA.

reaction function, namely the rate of inflation and the trend in output. In section 5 we summarize and conclude.

2. Updating the market evidence

For Germany and the UK we have daily data on money market rates over various maturities. For the UK, the sample period is from January 1984 until mid-October 2003. The market interest rates are the yields on Certificates of Deposits with a maturity of 1, 3, 6, and 12 months. This gave us about 5000 observations on each maturity. During this period, the Bank of England changed the official rate exactly 100 times. The sample period for Germany stretches from January 1989 until 21st July 2004. Market interest rates are the daily rates in Frankfurt for 1, 3, 6, and 12 months. During this period, the Bundesbank changed the discount rate 22 times and the ECB changed the policy rate 15 times.

Banks lend to each other on money markets and they will not borrow from each other at rates that differ greatly from that of the central bank. Furthermore, money markets are 'wholesale' markets dominated by very large trades carried out by very well-informed professionals seeking to exploit the smallest interest rate differentials. Consequently, money market interest rates should reflect the actual and expected path of the official rate. If money market participants expect the central bank to change the official rate, short-term money market rates will incorporate agents' expectations over the future policy rate. To the extent that agents guess correctly, money market rates will change *before* the change in the official rate occurs in order to avoid capital loss. We refer to this as anticipation of monetary policy.

How do agents form expectations of future official rates? If the official rate is set according to a monetary policy rule, a Taylor-type rule, for example, then, provided that the central bank published the rule, agents would have a relatively simple task. However, central banks have always denied that they operate such a rule, at least in a mechanical way, while not denying that the size of the output gap and the divergence of current inflation from target are important inputs to their decisions. (e.g. Bank of England, 2001 p.i) After all, if monetary policy decisions were simple rule-driven, one would not require a Monetary Policy Committee and several days of deliberation to make them (see Bean and Jenkinson, 2001)

However, because policy decisions are to some degree discretionary, agents do not have perfect knowledge of future Central Bank policy. Depending on the amount of policy transparency, some degree of surprise will remain and the yield curve will jump on the day of announcement, where the size of the jump depends (negatively) on the extent of policy transparency.

To extract some measure of policy surprise along the yield curve, we estimate the change in market interest rates for both countries as follows (Haldane and Read, 2000):

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

The subscript *j* stands for the term to maturity. The variable *mar* indicates the market rate, *pol* stands for the official rate and *D* is an impulse dummy.

For the UK, *D* takes the value 1 from November 1992 onwards and is zero otherwise. It is used to capture the effect of the introduction of inflation targeting in the UK. With inflation targeting, the Bank of England began to inform the public about its monetary policy decision process. In addition to the setting of a quantitative target for inflation, early examples of institutional reforms included the regular scheduling of meetings between the Chancellor of the Exchequer and the Governor of the Bank, the publication of minutes of their meetings and the quarterly *Inflation* Report. Later developments included the release of minutes and voting records of MPC meetings. Some of the examples are the publication of the inflation report, the regular MPC meetings and their reports, the publication of the voting behaviour etc.

For Germany, the dummy variable has the value 1 from January 1999 onwards and zero otherwise, in order to capture the potential effect of the regime shift from the Bundesbank to the ECB.

Lags of the dependent variable were included in equations for the UK and Germany, to reduce serial correlation. The coefficient λ measures the average interest rate surprise over the full sample. If $\lambda=0$, 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, a central bank interest rate change itself is no news. Only unexpected changes in macroeconomic variables would make the yield curve jump. Similarly, if $\lambda=1$, market agents are completely taken by surprise by central bank actions with all adjustment taking place on the day of the interest rate announcement.

For Germany, the coefficient δ measures the average change in market rates due to the regime shift from Bundesbank to ECB. If $\delta=0$, then there is no change in interest rate surprises due to the regime shift. If, as (some of) the financial press has suggested on various occasions, changes in the ECB policy rate are hard to anticipate, 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.

For the UK, δ measures the distinct effect of inflation targeting and the accompanying changes in public information of the decision making process on expected market interest rates.[3] If δ=0, then there is no shift in interest rate surprises due to the more transparent regime that has accompanied inflation targeting. We expect a negative sign for δ if inflation targeting made it easier for agents to anticipate Bank of England monetary policy. The sum of the coefficients δ and λ measures the size of the average interest rate surprise during the later period of greater central bank transparency.

Table 1 below shows the results of the coefficients λ and δ of equation (1) for both, the UK and Germany.[4]

Table 1: Comparison of policy surprise in short-term interest rates in Germany and UK

$Rate_j$	λ_j^{UK}	δ_j^{UK}	R_{UK}^2	λ_j^{Ger}	δ_j^{Ger}	R_{Ger}^2
1 Month	0.430 (4.90)	-0.322 (-3.03)	0.13	0.094 (2.32)	0.128 (1.35)	0.05
3 Months	0.133 (2.35)	-0.105 (-1.36)	0.02	0.077 (2.10)	0.103 (1.25)	0.08
6 Months	0.308 (4.05)	-0.300 (-3.39)	0.07	0.066 (2.47)	0.086 (1.37)	0.10
12 Months	0.248 (3.83)	-0.209 (-2.76)	0.05	0.058 (2.24)	0.089 (1.46)	0.07

The model was estimated with OLS. The t-values in brackets in Table 1 are calculated on the basis of Newey-West adjusted standard errors to ensure consistency.

Turning first to the results for the UK, we note the policy surprise coefficient λ is significant throughout the yield curve. Taking the sample period as a whole, between about 43 and 13 per cent of a policy rate change comes as a surprise on the day of the announcement. Throughout most of the maturity spectrum, the adjustment on the day is above 25 percent. Interestingly, the coefficient of the dummy variable is significant (except for the 3-month rate) and negative. This suggests that the movement to inflation targeting and the associated reforms in 1992, have made it easier for agents to anticipate Bank of England monetary policy. In the later period, only between 8 and 13 percent (= λ + δ) of the official rate change has to be corrected on the day of announcement.

[3] Earlier attempts to capture individual factors like publication of inflation report, MPC report etc. were not very successful in finding significant individual effects. This may be so because by the time this information is published, it s not anymore news (see eg Chadha and Nolan, 2001)
[4] The complete estimations may be obtained from the authors on request.

For Germany, policy surprise is substantially lower varying between 6 and 9 per cent over the whole sample period. The coefficient on the dummy variable is positive but it is always insignificant. Crucially, therefore, we do not find statistical evidence for the hypothesis that ECB interest rate decisions contain a greater surprise element than the former Bundesbank's. Furthermore, even during the ECB monetary policy regime, on average, agents anticipate changes in the official rate at least as well as they do under the Bank of England as other studies, listed in section 1, have found.[5]

3. Money market rate uncertainty

We have just seen that on average, agents' ability to anticipate central bank monetary policy has been high for both: Germany throughout the sample period and for the UK since 1992. Here, we extend the test for monetary policy anticipation by considering the *dispersion* of view. Our thinking here is that while, *on average* (or in the aggregate), agents' anticipation may not have changed, or even may have improved, it is perfectly possible for this to be accompanied at the same time by increasing uncertainty on the part of individual agents. What the results may be telling us about *average* behaviour, may be concealing a change in the degree of unanimity across agents. A greater dispersion of view would in turn indicate greater insecurity vis-à-vis monetary policy which would not show up in the estimations of the previous section. In the case of Germany, it may also shed some light on the difference between results from money markets which find policy anticipation high and the characteristics and survey evidence which find it low.

In order to measure the degree of unanimity with which private agents anticipate interest rate changes by the central bank over time, we looked at the range and standard deviation of forecasts by private institutions as reported in *Consensus Forecasts*. Every month, this publication shows the forecasts for, *inter alia,* the 3-month euro-DM interest rate (i.e. the rate on 3-month deposits in euros in Germany) and the 3-month interbank rate for the UK for some 25 private sector institutions (although this number of institutions reporting forecasts varies somewhat during the year). The forecasts are in both cases for 3 and 12 months ahead. We use two measures of volatility: the standard deviation of the forecasts of the private agents as reported in *Consensus Forecasts,* and 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 them over time. Any changes in the cross-sectional distribution of forecasts are interpreted as a change in the unanimity with which individual private agents forecast central bank policy. The

[5] see the studies listed in section 1.

sample period is from January 1994 until May 2004.[6] The aim of this section is to find out how the distribution of forecast views has changed over time. Thus we estimate for both countries the trend behaviour of this variation by the following equation:

$$Dispersion_{t,i} = \alpha_i + \beta_i(L)dispersion_{t,i} + \tau_i Trend + \varphi_i Trend^2 + e_t \qquad (2)$$

The dependent variable *dispersion* stands for the *forecast range* or the *forecast standard deviation* and the subscript *i* distinguishes between the quarterly and one-year ahead forecasts. Thus, the range of views about future interest rate developments is measured four ways: (1) by the 3-month-ahead and (2) the 1-year ahead forecasting range of the short-term money market rate, denoted by *3mRange* and *annualRange,* respectively, as well as by (3) the 3-month-ahead forecast standard deviation (*3mSD)* and (4) the 1-year-ahead forecast standard deviation (*annualSD*). The lagged dependent variable was included to reduce serial correlation.

Equation (2) models a non-linear relationship of forecast dispersions across time. This curve linear trend model allows a levelling off or accelerating of the change in unanimity over time. If agents find it easier (harder) over time to forecast, forecasting uncertainty declines (increases) over time and we expect a negative (positive) coefficient (τ_i) on the trend variable in both equations. Forecasting uncertainty in (2) may show (a) a decelerating positive slope ($\tau_i > 0, \varphi_i < 0$), (b) an accelerating positive slope ($\tau_i > 0, \varphi_i > 0$), (c) a decelerating negative slope ($\tau_i < 0, \varphi_i > 0$), or an accelerating negative slope ($\tau_i < 0, \varphi_i < 0$).

We turn to the empirical results and begin with those for Germany first (see Table 2 below)[7]. The estimation results of the previous section showed that on average, monetary policy anticipation has not changed over the sample period, despite the regime shift to the ECB. Thus, an interesting hypothesis to test for Germany is whether agents may have become more uncertain about their monetary policy predictions in the later (sample) period. If the hypothesis were correct that ECB policy has increased agents' forecasting uncertainty, we would expect the following estimation results of equation (2): Either, if τ were negative over the entire sample period, implying that over time agents have become more confident in forecasting monetary policy, then φ should be positive so that the falling trend flattens out as time goes on ('getting better but more slowly'); or, if τ were positive over the sample period, then φ should also be positive, indicating an accelerating rise in private agents' forecasting uncertainty ('getting worse and more quickly').

[6] Due to the lack of data, we cannot distinguish between pre- and post inflation targeting for the UK. We tried to test for a break in anticipation due to Bank of England independence. However, we could not find a significant break

[7] All estimations that involve model (2) use orthogonal trends in order to avoid correlation between the explanatory trend variables.

Table 2: Quarterly and annual forecasting volatility of the money market rates for Germany and the UK, based on equation (2)

Variable	α_i	β_i	τ_i	φ_i	R^2 [$\bar{R}^2$]	LM(2)
3mRange(G)	0.174* (5.77)	0.498* (5.67)	-0.0002 (-0.59)	0.0000 (0.60)	0.26 [0.24]	8.61* [0.014]
3mSD(G)	0.081* (5.89)	0.469* (4.99)	-0.000 (-0.03)	0.0000 (0.90)	0.26 [0.24]	1.78 [0.410]
annualRange(G)	0.270* (5.84)	0.550* (7.37)	-0.0008 (-1.48)	0.00005* (2.01)	0.55 [0.54]	8.95* [0.011]
annualSD(G)	0.107* (5.05)	0.585* (7.43)	-0.003 (-1.84)	0.00002* (2.63)	0.59 [0.59]	6.54* [0.004]
3mRange(UK)	0.359* (9.09)	0.269* (3.90)	-0.00147* (-3.65)	-0.0000 (-0.20)	0.26 [0.24]	0.32 [0.850]
3mSD(UK)	0.125* (5.29)	0.422* (3.88)	-0.0004* (-2.07)	0.0000 (0.07)	0.26 [0.25]	4.88 [0.087]
annualRange(UK)	0.607* (5.87)	0.430* (5.43)	-0.004* (-3.98)	0.000063* (2.89)	0.61 [0.61]	2.66 [0.264]
annualSD(UK)	0.181* (5.47)	0.586* (8.47)	-0.00108* (-3.83)	0.00002* (3.12)	0.75 [0.74]	2.26 [0.322]

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. LM(2) is the Lagrange multiplier test for serial correlation of order 2. In square brackets in the last column are the probability levels '*' indicate that coefficients or tests are significant at the 5% level of less.

Turning to the results of 3-month ahead forecast (*3mRange(G)*and *3mSD(G)*) for Germany first, we find that none of the trend variables explains the dependent variables. The results are slightly different for 1-year-ahead forecast uncertainty, where the squared trend variable is significantly positive (albeit just so for a*nnualRange(G)).* On the basis of these estimations it is not obvious that there is convincing evidence of a significant relationship between time and forecast uncertainty.

We continued to estimate an additional equation for Germany. This regression considers directly the effect of the regime shift in 1999 and is of the following form:

$$Dispersion_{t,i} = \alpha_i + \beta_i(L)Dispersion_{t,i} + \gamma_i D99 + \tau_i Trend + \delta_i D99Trend + e_t \qquad (3)$$

The dummy variable *D99* has, as before, the value 1 from January 1999 onwards and is zero otherwise. The coefficient γ measures the shift in the degree of uncertainty since 1999. If $\gamma = 0$, 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 average forecasting volatility of private agents. The coefficient τ measures the development of agents' uncertainty over time over the entire sample period. A negative τ-coefficient indicates over time increasing forecasting consensus of the private institutions reported in *Consensus Forecasts.* The coefficient δ measures the distinct change in the degree of uncertainty over time since the institutional change. The sum of the coefficients τ and δ measures the degree of agents' uncertainty over time during ECB policy. Again, lagged dependent variables were included so as to reduce serial correlation.

Table 3: Quarterly and annual forecasting volatility of the 3-month euro-DM rates based on (3)

Variable	α_i	β_i	γ_i	τ_i	δ_i	R^2 [$\bar{R}^2$]	LM(2)
3mRange	0.248* (4.47)	0.458* (4.43)	-0.063 (-0.64)	-0.0017* (-2.31)	0.002 (1.38)	0.28 [0.25]	7.82* [0.002]
3mSD	0.116* (4.79)	0.409* (4.03)	-0.017 (-0.50)	-0.0008* (-2.02)	0.001 (1.40)	0.29 [0.26]	1.28 [0.527]
annualRange	0.601* (5.57)	0.481* (5.44)	-0.522* (-3.63)	-0.006* (-3.22)	0.009* (3.82)	0.57 [0.56]	7.13* [0.003]
annualSD	0.234* (4.94)	0.515* (5.99)	-0.163* (-3.20)	-0.002* (-3.22)	0.003* (3.41)	0.62 [0.61]	3.87 [0.144]

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. LM(2) is the Lagrange multiplier test for serial correlation of order 2. In square brackets are the probability levels '*' indicate that coefficients and tests are significant at the 5% level of less.

We find that between 28% and 62% of the variation of average uncertainty is explained by the regressions. Three-month–ahead forecasting volatility is less well explained by variations over time than one-year-ahead uncertainty. Over the entire sample period, 3-month-ahead forecasting volatility falls over time (*3mRange* and *3mSD*), a trend which is not reversed in the later period. Over the whole sample period, mean forecasting uncertainty declines by 0.0017 (*3mRange*) and 0.001 (*3mSD*) percentage points per month. The shift dummy variables are insignificant in both cases, so that the average forecasting range and average level of the standard deviation have not altered since January 1999.

Turning to 1-year-ahead forecasting uncertainty, *annualRange* and *annualSD*, uncertainty falls on average over the whole sample period. However, this trend has been reversed since 1999. Over the sample period, the average forecasting range (average standard deviation) declines by 0.006 (0.002) percentage points per month, but during the ECB regime, uncertainty over interest rates in Germany has been rising on average well above the decline over the entire sample period.

Summarizing the results of table 3, both measures, forecasting range and standard deviation, suggest that uncertainty regarding the 3-month-ahead forecast of the euro-DM rate has been unchanged since the ECB took over monetary policy and has been falling throughout the entire sample period. However, the result is not so unambiguous for the one-year ahead forecasting range/standard deviation of the euro-DM interest rate. There we found that the downward trend has been 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 and standard deviation. The results of the one-year ahead forecasting range indicate that ECB policy has increased agents' uncertainty about the rate on 3-month German euro deposits at the one year horizon.

Comparing the results of Tables 2 and 3, generally model (2) seems to describe forecast volatility less satisfactorily than model (3).[8] On the basis of the results of these two different models, we may deduce that outcomes on 3-month-ahead forecast uncertainty are inconclusive concerning the overall trend; however, both models come to the same results that there is no change in uncertainty during the ECB policy period. For 1-year-ahead forecast uncertainty, we find some indication in both models for both volatility measures that euro-DM forecasting uncertainty has risen, particularly later on in the sample period.

[8] The explanatory power is slightly lower, most trend coefficients are insignificant and in three out of four estimations the diagnostic test is significant.

We turn now to the results for the UK and begin by returning to Table 2. Recall that the estimations of the previous section (2) showed that UK money markets have found it on average easier to anticipate monetary policy decisions since November 1992. Again, the aim of the estimations here is to test whether agents' *confidence* with respect to forecasting money market rates has changed over time, since attempts to improve agents' understanding of policy decisions have been to some extent incremental.[9]

The curve-linear trend model is a useful tool to test how the changes in the conduct of monetary policy have affected agents' confidence over time. If the increase in transparency enhanced agents' understanding and confidence, we would expect that uncertainty fell over time ($\tau_i \prec 0, \varphi_i = 0$). Bean (2005 pp.86-88) for example, in commenting upon the greater economic stability with which policymakers have been confronted in recent years suggests that part of the explanation is an improvement in policymaking itself. This suggests a sort of virtuous circle whereby (we can begin anywhere) improved policymaking improves stability which makes it easier for agents to anticipate the path of macro-variables and the reaction of the authorities for whom policymaking then becomes easier. In addition to any achievements in policymaking, the passage of time is inevitably relevant since, for any given regime, time enables agents to learn by experience. Whadhwani (2001, p.355) suggests that agents' required two years (1997-99) to 'learn' about the reactions of the MPC. And it is a general theme of Thornton (2003) that what *really* improves policy outcomes is the stability of regime combined with consistent behaviour. In these circumstances, time alone will ensure that agents understand how the monetary authority behaves, without any of the currently fashionable 'transparency characteristics'. If learning is important, it may even be that over time, agents' uncertainty falls more rapidly ($\tau_i \prec 0, \varphi_i \prec 0$).

The results in Table 2 show that between 26% and 75% of the variation in the volatility measures are explained by the non-linear trend model. Both measures (*3mRange(UK)* and *3m SD(UK)*) indicate, as the literature generally implies, that 3-month-ahead forecast uncertainty has declined throughout the sample period. On average, uncertainty fell by 0.0015 (*3mRange(UK)*) and 0.0004 (*3mSD(UK)*) percentage points per month. Similarly, one-year-ahead forecasting uncertainty also has declined, but at a falling rate. In fact, from mid-1996

[9] For example, while the march towards openness begins famously with inflation targeting and the publication of the *Inflation Report* in November 1992, 1994 saw the introduction of a regular schedule of meetings between the Chancellor and Governor and the publication of minutes of their meetings. May 1997 saw the Bank of England given operational independence and a shortening in the lag between decision meetings and the publication of minutes. Wadhwani (2001) argues that 1999 marks another significant date since by then agents have had sufficient time to 'learn' how the MPC works.

onwards, the curve flattens out and uncertainty begins to rise again thereafter.[10] This outcome is not in line with the idea that greater Bank of England policy transparency increases markets' understanding and implicitly reduces uncertainty. We think that the following section may shed some light on this result.

What is the difference between German and UK results so far? For both countries, there is evidence that forecasting uncertainty declines over time. The dispersion of 1-year-ahead forecasts initially declines, but this trend is reversed later on in both countries. As with average views (see section 2), so too with the dispersion of views a rather similar picture of monetary policy anticipation emerges for both countries.

4. Explaining short-term interest rate uncertainty

The change in uncertainty over forecasting market interest rates in both countries over time could have a number of possible explanations. However, if there is a consensus that deviations of current from target inflation and changes in the output gap are important inputs into central bank reaction functions,[11] then one obvious hypothesis that we must test is that agents have become more (or less) certain in their inflation and GDP forecasts too. Thinking in terms of a reaction function, the point here is that while agents may be reasonably knowledgeable about the magnitude of the coefficients, they may become more or less certain about the magnitudes to which the coefficients apply. 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 uncertainty of money market rates varies with the forecasting uncertainty of, say, the inflation rate or the relationship of output to trend.[12] The uncertainty about future inflation (or economic growth), will then show up in a greater spread of the forecasts of money market rates.

Agents' uncertainty about macroeconomic development may change 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

[10] The point in time (t) of the 'flattening out' of the trend can be calculated as the first derivative with respect to time and set equal to zero: $\frac{\delta y}{\delta t} = \tau + 2\varphi t = 0$ so that $t = \frac{-\tau}{2\varphi}$.

[11] See Stuart (1996) for the UK.

[12] Mervyn King might be right that in an ideal policy world the 'news' would be in the movement of the macroeconomic variables but if that news is hard to extract, monetary policy could still have its exciting moments.

institutions may initially cause greater uncertainty for agents until these institutions have been established for some years or so.[13]

The latter may be particularly relevant for the German estimations. 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 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, especially since there is feedback to these variables from the authorities' policy decisions and since because of the new regime the nature of the feedback has become uncertain. Furthermore, this injection of uncertainty into the way in which *current* interest rate decisions affect the future path of relevant macro variables will increase with the forecast horizon. Current interest rate decisions may have little effect on relevant magnitudes three months hence, but will very likely have some impact in a year's time.

In the following sections, we estimate agents' uncertainty regarding inflation and GDP growth. Finally, we test whether inflation uncertainty explains uncertainty in market interest rates.

For both countries, we use monthly data for inflation and real GDP growth, each predicted one year ahead (only). Again, we calculate the forecast range and use the reported standard deviation to measure macroeconomic forecast uncertainty. For the UK, the sample period is from January 1994 until May 2004. For Germany, the sample period for the one-year-ahead inflation forecast range is from January 1994 until May 2004 and for the one-year-ahead GDP growth range it is from June 1994 until May 2004. Forecasts for GDP growth refer to unified Germany throughout. Inflation forecasts are reported for West Germany until September 1997, only. We use equations (2) and (3) above, replacing the dependent variable therein by the one-year-ahead inflation and one-year-ahead real GDP growth forecasting range or standard deviation, respectively.[14] The results of the estimations of equation (2) are shown in Table 4 below:

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[13] See again Wadhwani (2002, p.355)

[14] In the German case, 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 is not reported here.

Table 4: Quarterly and annual forecasting volatility of the inflation rate and GDP growth for Germany and the UK based on equation (2)

Variable	α_i	β_i	τ_i	φ_i	R^2 [$\bar{R}^2$]	LM(2)
Inflationrange(G)	0.360* (6.11)	0.407* (4.10)	0.001896* (5.11)	0.0000206* (1.99)	0.52 [0.51]	5.24 [0.073]
inflationSD(G)	0.161* (7.36)	0.353* (4.25)	0.000883* (3.96)	0.0000103* (2.20)	0.51 [0.50]	3.62 [0.164]
GDPRange(G)	0.459* (7.65)	0.379* (4.55)	-0.0002 (-0.44)	0.0000 (1.50)	0.20 [0.17]	2.58 [0.323]
GDPSD(G)	0.151* (7.03)	0.497* (7.44)	-0.0002 (-107)	0.00001* (1.96)	0.32 [0.30]	0.65 [0.722]
Inflationrange(UK)	0.359* (4.48)	0.516* (5.51)	-0.00681* (-4.80)	0.000121* (4.63)	0.89 0.89	4.77 [0.092]
inflationSD(UK)	0.149* (4.51)	0.511* (5.24)	-0.001981* (-3.73)	0.0000413* (3.84)	0.87 0.87	2.84 [0.242]
GDPRange(UK)	0.385* (5.16)	0.608* (8.04)	-0.00274* (-3.90)	0.0000327* (2.30)	0.72 0.71	0.179 [0.915]
GDPSD(UK)	0.168* (4.30)	0.582* (6.48)	0.00006 (0.22)	0.0000223* (3.25)	0.49 0.47	4.81 [0.090]

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. LM(2) is the Lagrange multiplier test for serial correlation of order 2. In the last column in square brackets are the probability levels '*' indicate that coefficients and tests are significant at the 5% level of less.

We first turn to the results for Germany. The dispersion of GDP forecasts is not explained by the trend variables in the curve-linear trend model. A glance at Table 5 below also shows that there does not seem to be a systematic relationship between GDP forecast uncertainty and the trend model. However, the results are quite different for the variance of views about inflation. The non-linear trend model provides clear evidence for a rise in inflation forecast uncertainty throughout the sample, with an accelerating positive slope. Rising inflation uncertainty is confirmed by the results presented in Table 5 where inflation uncertainty has been rising since January 1999.

Table 5: Annual forecasting range and standard deviation of the inflation rate and GDP growth for Germany based on equation 3.

Variable	α_i	β_i	γ_i	τ_i	δ_i	R^2 [$\bar{R}^2$]	LM(2)
Inflationrange(G)	0.315* (5.14)	0.410* (3.82)	-0.109 (-1.20)	0.001 (0.23)	0.002* (2.11)	0.52	5.84 [0.054]
inflationSD(G)	0.155* (6.35)	0.329* (3.72)	-0.068 (-1.93)	-0.0002 (-0.56)	0.0016* (2.92)	0.52	4.47 [0.107]
GDPRange(G)	0.555* (6.71)	0.349* (3.86)	-0.222 (-1.60)	-0.0014 (-1.22)	0.004 (1.88)	0.22	0.085 [0.959]
GDPSD(G)	0.199* (6.77)	0.475* (6.82)	-0.078 (-1.80)	-0.001 (-1.63)	0.0013* (1.97)	0.31	0.534 [0.766]

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. LM(2) is the Lagrange multiplier test for serial correlation of order 2. In square brackets are the probability levels '*' indicate that coefficients are significant at the 5% level of less.

The results for the UK, as presented in Table 4, show the following: contrary to the German results, GDP forecast volatility changes over time in the UK and, particularly, it rises later on in the sample period. Also in contrast to the German estimation results, inflation forecast uncertainty falls over time, albeit, at a declining rate. The point in time at which the curve flattens out and begins to rise appears to lie in the first half of 1996. This is at approximately the same time as we found a rise in interbank rate uncertainty in the UK. For the UK therefore, there does appear to be some association between increasing uncertainty about future interest rates and increasing uncertainty about the future path of inflation, from the mid-1990's. We return to this, and a possible explanation, below.

How does the notion of transparency relate to the diverse changes in the dispersion of inflation forecasts in both countries? We discussed before the two way effect between money market rate uncertainty and inflation uncertainty: a predictable monetary policy will reduce interest rate volatility which itself reduces inflation volatility and, inflation volatility determines market uncertainty through the CB reaction function. In the previous section we found already that Bank of England transparency does not seem to have led to a greater unanimity of money market forecasts than is apparent in the Bundesbank/ECB policy regime. So, the remaining issue is whether changes in inflation volatility may have caused changes in money market uncertainty.

The second part of this section is concerned with testing for the effect of inflation uncertainty on market rate uncertainty. For both countries, we only replace the trends in the regression equations by volatility of inflation and the dependent variables are the one-year-ahead interest rate forecast dispersions. Table 6 below presents the results.

Table 6: Annual forecasting range and standard deviation of the money market rates and inflation volatility for Germany and the UK

Variable	α_i	β_i	c_1	R^2 [$\bar{R}^2$]	LM(2)
annualSD(G)	0.066* (2.63)	0.737* (10.41)	0.058 (1.07)	0.56 [0.56]	11.16* [0.004]
annualRange(G)	0.189* (2.90)	0.706* (9.20)	0.118 (0.69)	0.51 [0.50]	13.16* [0.001]
annualSD(UK)	0.119* (5.28)	0.635* (10.54)	0.060* (4.25)	0.75 [0.74]	7.76* [0.021]
annualRange(UK)	0.419* (5.56)	0.435* (4.62)	0.242* (3.95)	0.62 [0.61]	2.92 [0.318]

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. LM(2) is the Lagrange multiplier test for serial correlation of order 2. In square brackets are the probability levels '*' indicate that coefficients are significant at the 5% level of less. The coefficient c_1 refers to the variable inflation forecast volatility.

There is no evidence for Germany that one-year-ahead euro-DM uncertainty is affected by dispersion of views about inflation. This result is perhaps not that surprising. Policy rates are set by the ECB and the relevant inflation rate for ECB policy purposes is based on the *Harmonised Index of Consumer Prices* for the euro area.[15] In other words, we may be looking ~~look~~ at the 'wrong' inflation rate. However, when we estimated over the shorter period, before EMU, the range of inflation forecasts was not a significant explanatory variable for interest rate forecast dispersion. We therefore may conclude that the rise in money market uncertainty may be due to the regime change and with it agents' difficulty to confidently forecast ECB policy.

For the UK, the results are clear: inflation uncertainty increases the uncertainty of one-year-ahead forecasts of interest rates. In other words, the rise in inflation uncertainty (see Table 4) increases monetary policy uncertainty. The interesting question is why should this uncertainty have surfaced in 1996. One year later and one might have pointed to the independence of the

[15] *Consensus Forecasts* has published euro area statistics only since January 2003.

Bank of England and a partially new operating regime, but this came generally as a surprise and so it is difficult to argue that the uncertainty reflects an expectation of a regime change.

Some evidence is provided in the Bank of England's *Inflation Reports* for 1996. In each quarterly issue, section 6 discusses 'prospects for inflation'. This discussion centres around the famous fan charts showing the forecast path of inflation as a probability distribution. It is clear from a comparison of the charts from one issue to the next that the 'fan' becomes more dispersed. This increase in the uncertainty of its own forecasts is acknowledged by the Bank in the November *Report* (Bank, 1996b p.44). Moreover, beginning in February 1996, section 6 of the *Report* included a subsection titled 'other inflation projections' wherein the Bank commented on other forecasters' projections, both as regards their median values and the dispersion. In the August issue the Bank comments 'Unusually, the spread of views for 1997Q4 has not narrowed…the interquartile range has widened slightly to 2.5%-3.3%' (Bank, 1996a, p.46). The term 'unusually' is used because the Bank is referring specifically to the behaviour of one year ahead forecasts; the increased dispersion of view is absent at shorter horizons.

In so far as an explanation is offered, it centres on the behaviour of the exchange rate, which had become very volatile, appreciating by 8 per cent between the August and November *Reports* alone (Bank, 1996b pp. 41, 45). It is interesting to note that the standard deviation of monthly data for the sterling effective exchange rate between the introduction of inflation targeting in November 1992 and the middle of 1996 is just 1.8; from late 1996 to the end of 2000, a period of roughly comparable length, the standard deviation is 8.05.[16] It is hard to escape the conclusion that agents had become familiar with the Bank's post-inflation targeting reaction function and its coefficients, and had become reasonably confident in handling the feedback from interest rate decisions to the inflation and output inputs, all in a period of relative exchange rate stability. This ends quite suddenly in 1996. From then on, it becomes much more difficult to forecast the future path of inflation, at least at horizons like a year or more, and thus of the Bank's likely reaction at similar horizons. Such uncertainty may or may not have been supplemented by the reforms in May 1997, but it was already well-established by then.

5. Conclusion

An increase in monetary policy transparency should reduce the degree of policy 'surprise' at the short end of the yield curve. Since November 1992 the Bank of England has introduced a succession of reforms aimed at increasing transparency. Our tests suggest that UK money

[16] Calculated from the series XUMABK on the Bank of England's database.

market agents have, *on average*, found it much easier to anticipate Bank of England policy moves since 1992.

We also measured the degree of monetary policy surprise for Germany under the Bundesbank and ECB regimes. Generally, agents have found it, *on average,* at least as easy to predict policy rate moves under both compared to the Bank of England regime, notwithstanding the fact that the Bundesbank was always a rather secretive institution and that the ECB has also been criticised at least for a lack of clarity. Furthermore, there is no discernible difference in average anticipation due to the regime change from Bundesbank to ECB.

This result, that two central banks with different transparency characteristics and reputations can both conduct efficient monetary policy, does not support the view that institutional reforms alone reduce *average* policy surprises. However, transparency should have additional benefits which cannot be detected from this type of analysis. Transparency should help markets to become more certain in their forecasts of future interest rates. Our cross sectional analysis showed for *both* countries that short-horizon forecast dispersion has fallen over time. Initially, in *both* countries, diversity of long horizon forecasts has also fallen, but then picked up in *both* countries at a later period. If transparency were an important factor in determining market rate uncertainty, we would have expected that interest rate uncertainty were falling consistently over time and more under the Bank of England than under the Bundesbank/ECB regime. Our results show, by contrast, that market interest rate uncertainty behaves similarly over time under both regimes. Again, this suggests that something other than institutional characteristics is at work.

One possible candidate is inflation uncertainty which could affect the spread of market rate forecasts through the central bank's reaction function. If so, a reduction in the dispersion of macroeconomic forecasts may be an additional explanation to transparency for any reduction in market rate forecast spreads and vice versa. The estimations show that there is clear evidence that inflation uncertainty has risen in Germany. We tested for the effect of inflation uncertainty on interest rate uncertainty, but we could not conclude that the rise in inflation uncertainty was responsible for the rise in long-horizon market rate dispersion. For the UK the results are more complex. Initially, inflation uncertainty falls in the UK, but this trend is reversed later on in the sample period. We find strong evidence that diversity of inflation forecasts explains market interest rate uncertainty in the UK. This may be one of the reasons for why long-horizon market rate forecast dispersion has risen and is similar at the end of the sample period under both regimes.

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