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What's behind the survey values? An analysis of individual forecasters' behaviour

by
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This paper studies the internal consistency of professional forecasts on a micro level using three alternative data sets. The analysis is mainly based on the ECB Survey of Professional Forecasts for the euro area, but for comparison we also study the Consensus Economics survey and Survey of Professional Forecasts for the US. Forecast uncertainty is explored using two alternative measures, the conventional standard deviation of individual point forecasts and the mean uncertainty based on subjective probability distributions of survey respondents. Our analysis indicates that individual forecasters' price and real GDP expectations are positively related, but that forecasters deviate systematically from each other. We also find clear evidence that individual forecasters form expectations according to the hybrid specification of the New Keynesian Phillips curve. On a micro level, inflation uncertainty seems to be closely related to output uncertainty. However, the relationship between alternative measures of uncertainty is relatively weak.

Keywords: *Forecasting, Survey data, Expectations, Phillips curve*

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1. Introduction

Survey data have been widely used to study inflation expectations and other macroeconomic variables (see Pesaran and Weale, 2006; and Sinclair, 2010 for basic references of survey-based studies). Recently, increased macroeconomic volatility during the financial crisis has emphasised the need to analyse forecast uncertainty. An obvious way to measure uncertainty is to use survey data, which are nowadays collected in several studies.

Typically, surveys publish only mean or median values of individual forecasts, along with corresponding conventional standard deviations as a measure of expectations disagreement. However, the ECB Survey of Professional Forecasters (ECB SPF) enables a richer analysis of forecast uncertainty, based on probability distributions of individual respondents' expectations.[1] Contrary to many other surveys, the ECB SPF survey provides both *fixed event* and *fixed horizon* forecasts for different time horizons (terminology is from Dovern et al., 2012). *Fixed event* forecast refers to a certain calendar year (for example, the next calendar year) and *fixed horizon* forecast to a certain time period ahead (e.g. four quarters ahead). In some studies, fixed horizon forecasts are approximated using weighted averages of fixed event forecasts (see e.g. Gerlach, 2007).

The main purpose of this study is to investigate the internal consistency of individual survey expectations. By internal consistency we mean that expectations and actual data behave in the same way for different variables like inflation and output growth. Thus, if these variables are positively (strongly/weakly) correlated in the actual data, we would expect that the corresponding expected values are also positively (strongly/weakly) correlated. We examine that with both individual inflation and output growth expectations and expectation errors. This is done by scrutinising simple bi-variate relationships at different forecast horizons and using the standard New-Keynesian Phillips curve as the underlying specification for both sets of variables. This comparative analysis is the main purpose of the paper. We also compare alternative measures of forecast uncertainty for different variables and scrutinise the relationships between inflation and output growth uncertainties. This is the second purpose of the paper. In addition to these analyses of different relationships, we carry out some more technical analyses: we compare fixed horizon forecasts to corresponding approximations based on weighted averages of fixed event forecasts. Finally, we examine the heterogeneity of individual expectations. In all analyses, special attention is paid to the impact of the recent financial and Euro crisis on individual expectations, especially in terms of forecast uncertainty.

The empirical analysis is mainly based on the ECB Survey of Professional Forecasts for the euro area. For comparison, we also consider the Consensus Economics survey (CF) and Survey of Professional Forecasts for the US (US SPF). Both fixed event and fixed period expectations are used in these analyses. Two alternative measures of forecast uncertainty are also employed: the standard deviation of point forecasts and the mean uncertainty based on probability distributions of survey respondents. These measures are typically used for policy purposes, but in this context relatively little attention is paid to uncertainty measures and other distributional issues (see Schnader and Stekler, 1991; and Kolb and Stekler, 1996 for a more thorough analysis of consensus in forecasting).[2]

Our results suggest that surveys are useful for analysing changes in inflation and inflation uncertainty, albeit some measurement problems are involved. For instance, we find that basing forecasts on weighted averages of fixed event forecasts may not be the optimal way to approximate fixed horizon forecasts. The analyses provide evidence of systematic differences across individual forecasts. On a micro level, future price and real GDP growth expectations are positively related, and individual forecasters seem to form expectations according to the hybrid specification of the New Keynesian Phillips curve. As regards uncertainty, inflation uncertainty seems to be closely related to output uncertainty. However, the relationship between alternative uncertainty measures is relatively weak.

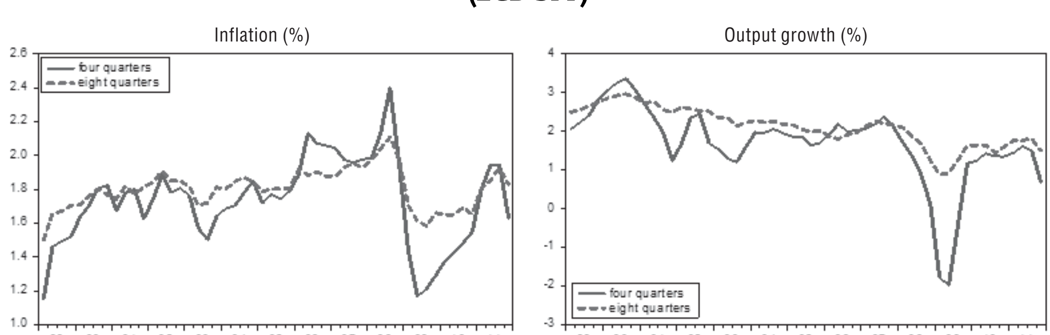
Next, we consider the basic features of the data, then in Section 3 we analyse the relationships between different survey variables, in Section 4 we scrutinise the uncertainty proxies and in Section 5 we present some concluding remarks.

2. Alternative data sets

Of the numerous survey sources of micro-level survey data we use the quarterly Survey of Professional Forecasters of the European Central Bank (ECB SPF) as our main data source.[3] Since 1999, the ECB has asked a panel of some 75 forecasters about their short- and long-term views of HICP inflation, real GDP growth and unemployment in the euro area. Respondents represent the financial sector, non-financial research institutes and employer or employee organisations in the European Union (EU). Both *fixed event* forecasts and *fixed horizon* forecasts for different time horizons are surveyed. In addition to the point estimates, probabilities surrounding point estimates (density forecasts) are published for all variables and all horizons.[4]

Mean expectations of inflation and real GDP growth one and two years ahead in the ECB SPF survey are displayed in Figure 1. Until mid-2008, the forecasts were quite stable, but after that the price and output forecasts decreased sharply and the forecasting errors expanded substantially. After 2009, the expectations and expectations errors returned to more or less "normal levels". As shown in Figure 1, long-term forecasts are typically more stable than short term forecasts.

Figure 1. **Forecasts of inflation and output growth for one and two years ahead (ECB SPF)**



For the sake of comparison, two surveys for the US are also analysed: Consensus Forecasts survey provided by Consensus Economics (CF) and the Survey of Professional Forecasts provided by the Federal Reserve Bank of Philadelphia (US SPF). Two surveys are used because they are both somewhat different from the ECB SPF survey (see Annex A). The CF survey, which has been conducted since 1989, publishes forecasts for the US and many other industrialised countries every month. Respondents in this survey are public and private economic institutions in all major economies. The US SPF is a quarterly survey, which began already in 1968Q4. It includes over 30 variables for different forecast horizons. Both surveys provide expectations on a micro level. Consensus Forecast provides only *fixed event* forecasts of several macroeconomic variables while the US SPF survey publishes both *fixed event* and *fixed horizon* forecasts.

We follow Gerlach (2007) and Dovern et al. (2012) and approximate *fixed horizon* forecasts by weighted averages of *fixed event* forecasts. Denote by $F[y_0,m,y_1(x)]$ the *fixed event* forecast of variable x for year y_1 made in month m of the previous year, y_0, and by $F[y_0,m,12(x)]$ the *fixed horizon*, twelve-month-ahead forecast made at the same time. We can then approximate the *fixed horizon* forecast for the next twelve months as the average of forecasts for the current and next calendar years weighted by their shares in the forecasting horizon:

$$F[y_0, m, 12(x)] = [(12 - m)/12] * F[y_0, m, y_0(x)] + (m/12) * F[y_0, m, y_1(x)] \quad [1]$$

For example, the July 2010 twelve-month-ahead forecast of inflation rate $F[2010, 7, 12(\Delta p)]$ is approximated by the sum of $F[2010, 7, 2010(\Delta p)]$ and $F[2010, 7, 2011(\Delta p)]$ weighted by 5/12 and 7/12 respectively. Using Equation [1], we construct expected inflation and real GDP growth series for both the US (using the CF survey) and the euro area (using the ECB SPF survey).

Next, we assess the empirical relevance of Equation [1] using the ECB SPF survey. Figure 2 illustrates the relationship between fixed horizon data and constructed series, and Table 1 provides a test of the equality of the series. It is a bit disturbing to see that the original *fixed horizon* data seem to differ from the constructed series. The deviation is quite

Figure 2. **Relationship between survey forecasts four quarters ahead and corresponding approximations based on Equation [1] (ECB SPF)**

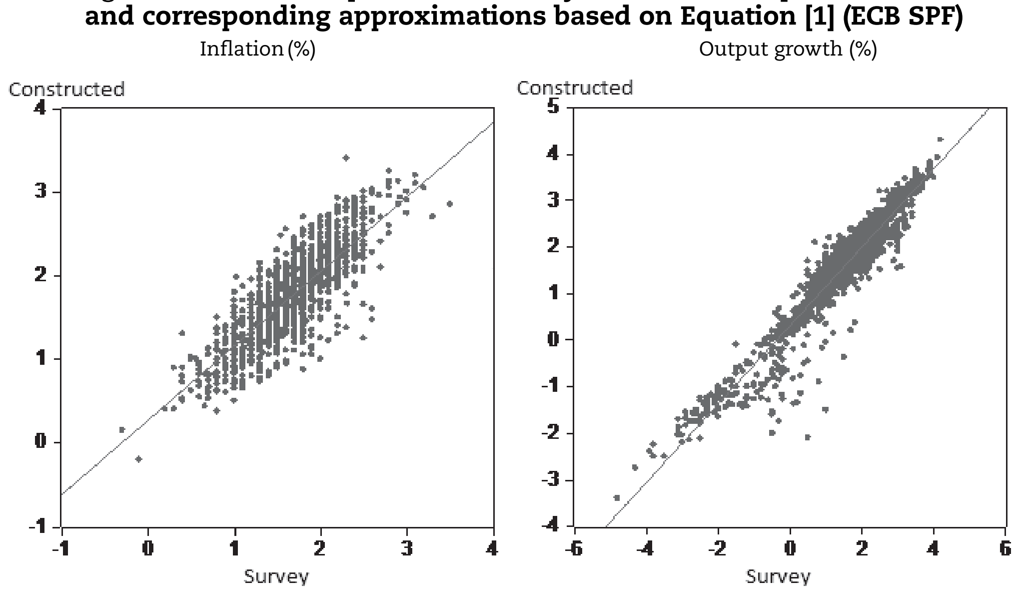


Table 1. **Comparison of actual and constructed forecast data in the ECB SPF survey**

Test of equality of the ECB SPF time series

	t1	t2	R2	SEE	DW	F
$\Delta p^e_{it,4} = .335 + .770\Delta p^e_{it,4g}$	14.27	61.61	0.684	0.219	1.23	
$\Delta p^e_{it,4} = -.418 + 1.185\Delta p^e_{it,4g}$	11.13	57.61	0.800	0.174	1.55	29.38
$\Delta y^e_{it,4} = -.207 + 1.085\Delta y^e_{it,4g}$	7.35	84.43	0.915	0.320	1.49	
$\Delta y^e_{it,4} = -.308 + 1.144\Delta y^e_{it,4g}$	4.78	31.22	0.940	0.271	1.58	20.78

Notes: $\Delta p^e_{it,4}$ ($\Delta y^e_{it,4}$) denotes the original inflation (output growth) forecast four quarters ahead in the survey and $\Delta p^e_{it,4g}$ ($\Delta y^e_{it,4g}$) the corresponding four-quarter forecast from the fixed event (current and next calendar year) forecasts computed via Equation [1]. t1 and t2 denote the (corrected) t-ratios of the coefficients and the F test statistic for fixed period time effects. All estimates are OLS estimates which include cross section fixed effects. Equations [2] and [4] also include period fixed effects.

noticeable for inflation, whereas for output growth the difference is more moderate. But in both cases equality of the two series is clearly rejected (Table 1). The results for fixed time effects (Equations [2] and [4] in Table 1) suggest that to some extent the difference is related to specific periods. The results can be interpreted in many ways, but the most obvious interpretation is that, instead of making mechanical calculations, forecasters do indeed have in mind some nontrivial path of future inflation and output growth when they form expectations. Therefore, in empirical studies, expectations based on weighted averages should be interpreted with caution.

3. Empirical evidence

In this section, we explore the internal consistency of survey expectations on a micro level. More precisely, we investigate individual forecasters' trade-off between inflation and real activity. In practice, this means estimating the Phillips curve. Phillips curves have been estimated extensively, even with micro data. Micro-level analysis has not been done for the euro area, whereas Fendel et al. (2011) have used individual Consensus Forecast data to explore the Phillips curve relationship in G7 countries. For the US, individual FOMC forecasts have been used to study the relevance of the Phillips curve (Tillmann, 2010) and to examine the Taylor rule in monetary policy (Fendel and Rülke, 2012). Earlier in Kortelainen et al. (2011b), we used a VAR model to study the relationships between different forecast variables (expectations). The results of this analysis appeared to be consistent with the idea of a New-Keynesian macro model, in particular with a New-Keynesian Phillips curve.

First, we scrutinise cross-plots of individual inflation and real GDP growth forecasts in the ECB SPF survey. One year- and two years-ahead relationships are displayed in Figure 3. Both panels indicate that individual forecasters have quite heterogeneous views about the future trade-off between inflation and output. Views regarding the Phillips curve seem to be even more divergent for the shorter forecast horizon. Even so, the two variables are positively related at both forecast horizons.

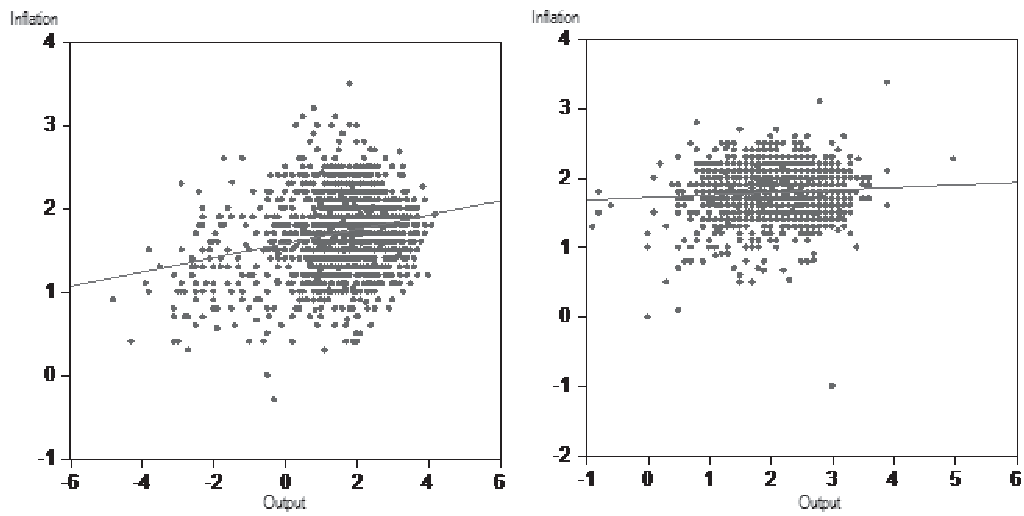
Next, we examine in more detail the heterogeneity of individual forecasts in the ECB SPF survey. For that purpose, we test the importance of cross-section fixed effects and period fixed effects in the panel regression:

$$\Delta p^e_{it,T} = c + c_i + c_t + u_{it} \qquad [2]$$

where $\Delta p^e_{it,T}$ denotes inflation expectations of forecaster i for period T, assessed in period t. The term c is a constant and c_i refers to cross section fixed effects, c_t to period

Figure 3. **Relationship between inflation and output growth forecasts (ECB SPF)**

One year ahead | Two years ahead



fixed effects. The error term, which is assumed to be uncorrelated, is denoted by u_{it}. As dependent variables, we consider forecasts for fixed calendar years $T = t + 0$, $T = t + 1$, $T = t + 2$ or $T = t + L$ (where L refers to long term) as well as fixed horizon forecasts for four quarters ahead ($T = t + 4$), eight quarters ahead ($T = t + 8$) and 20 quarters ahead ($T = t + 20$). In all cases, we test the hypothesis according to which both the cross section fixed effects c_i and period fixed effects c_t are the same across forecasters (see F test statistics in Table 2).

Table 2. **Testing the importance of fixed effects in the ECB SPF survey**

Dependent variable	Degrees of freedom	F	X^2
Fixed event forecasts			
Δp^e_{t+0}	99 2880	2.71	152
Δp^e_{t+1}	98 2806	6.09	264
Δp^e_{t+2}	93 1034	4.35	258
Δp^e_{t+L}	97 1993	10.93	812
Fixed horizon forecasts			
Δp^e_{t+4}	96 2551	5.95	270
Δp^e_{t+8}	96 2771	6.44	422
Δp^e_{t+20}	65 62	4.50	214

Notes: Tests are based on OLS regression (2). The SUR estimator could not be used for the whole data set, because of missing observations (unbalanced panel). A balanced panel with 21 forecasters was used, however. It turned out that with these data, the test statistics became much larger (e.g., with Δp^e_{t+4} the F statistic increased from 4.25 to 22.47).

We also test the restriction that the relationship between inflation and output growth forecast is the same for all forecasters (see Chi-squared test statistics in Table 2). All test statistics indicate rejection of the null hypothesis of equal coefficients. Only for current period values (first row) do the significance levels come close to 0.001, which indicate that the difference between individual coefficients is not of several light-years' magnitude. Otherwise, the differences between individual forecasts are large and persistent.

After dealing with these measurement issues, we explore how the survey respondents' views of future price and output developments are related to each other in the ECB SPF survey (see Table 3). First, using alternative fixed event and fixed horizon forecasts, we

Table 3. **Relationship between inflation and output growth forecasts in the ECB SPF survey**

Dep. var.	Const.	Δy^e_{t+4}	$\Delta y_{t+4} - \Delta y^e_{t+4}$	Δy^e_{t+8}	Δy^e_{t+0}	Δy^e_{t+1}	y^e_{t+2}	Δy^e_{t+L}	R^2/SEE
Fixed horizon forecasts									
Δp^e_{t+4}	1.596	0.082							0.169
	(96.27)	(10.20)							0.358
$\Delta p_{t+4} - \Delta p^e_{t+4}$	0.453		0.258						0.287
	(25.56)		(22.06)						0.663
Δp^e_{t+8}	1.697			0.049*					0.196
	(57.68)			(3.75)					0.270
Fixed event forecasts									
Δp^e_{t+0}	1.628				0.219*				0.280
	(127.81)				(33.29)				0.561
Δp^e_{t+1}	1.607					0.090*			0.137
	(62.35)					(7.56)			0.343
Δp^e_{t+2}	1.721						0.050*		0.230
	(39.03)						(2.54)		0.248
Δp^e_{t+L}	2.030							-0.057*	0.342
	(36.66)							(2.21)	0.196
Phillips curve estimates		Δy^e_t	Δp^e_{t+1}	$s1^*\Delta p^e_{t+1}$	$s2^*\Delta p^e_{t+1}$	$s3^*\Delta p^e_{t+1}$	$s4^*\Delta p^e_{t+1}$	$\Delta^e p_{t-1}$	R^2/SEE
Δp^e_t		0.108	1.003						0.508
		(16.84)	(127.11)						0.457
Δp^e_t		0.111		0.364	0.511	0.551	0.485	0.485	0.694
		(17.32)		(17.42)	(25.72)	(26.17)	(22.91)	(22.54)	0.348
Δp^e_t		0.130		0.268	0.411	0.450	0.401	0.524	0.682
		(17.32)		(11.07)	(18.13)	(18.63)	(15.91)	(21.73)	0.352
Δp^e_t		0.151		0.858					0.507
		(11.32)		(55.17)					0.329
Δp^e_t		0.088			1.010				0.482
		(5.98)			(60.00)				0.429
Δp^e_t		0.103				1.071			0.618
		(8.69)				(77.85)			0.456
Δp^e_t		0.119					1.045		0.465
		(9.68)					(67.64)		0.528

Notes: Numbers inside parentheses are corrected t-ratios. Δp_{t+4} denotes expected inflation for the subsequent four quarters and Δp_{t+1} the corresponding measure for the next calendar year. Δp_{t+L} denotes the long-run inflation expectations. The growth rate of output, Δy^e_t, is defined accordingly. The last seven rows represent a (hybrid) Phillips curve. All equations were estimated by OLS, the simple equations on rows 1-6 also include cross-section fixed effects. s1-s4 are seasonal dummies. Equations in the last four rows are estimated with the first, second, third and fourth quarter data only. Δp and Δy denote actual inflation and output growth, respectively.

explore whether inflation and output growth expectations are positively correlated (for example, in the case of forecasts four quarters ahead, we examine how Δp^e_{t+4} and Δy^e_{t+4} are related). The relationship between corresponding expectation errors, i.e. between $(\Delta p_{t+4} - \Delta p^e_{t+4})$ and $(\Delta y_{t+4} - \Delta y^e_{t+4})$, is also examined. Then, we estimate alternative specifications of the Phillips curve relationship. For comparison, we estimate Phillips curves also for the US using the CF survey (see Table 4). In this case expectations variables are constructed via Equation [1]. Our analytical framework is quite straightforward mainly because we have just two variables (for a more sophisticated approach in a multivariate setting, see Sinclar et al., 2012; and Komunjer and Owyang, 2012).

The first six rows in Table 3 indicate that inflation and output growth expectations and the corresponding expectation errors are indeed positively correlated in the euro area. Only if we consider long run (five-year) expectations, does the relationship seem to vanish. Thus, forecasters seem to believe that in the future rising prices will be related to increasing real activity. The finding is consistent with the basic features of the data (see Figure 3).[5]

Estimation results for the US with the Consensus Forecast data (and a much longer sample period) in Table 4 confirm that inflation and output forecasts are indeed positively correlated in the US, although allowing for both cross-section and period time effects produces rather low t-ratios for the respective coefficients. When the cross-section fixed effects are eliminated, the t-values increase substantially, to 3.42 for Equation [1] (first row) and 7.41 for Equation [2] in Table 4. This finding is consistent with evidence on Dutch households (see Christensen et al., 2006), although the relationship seems to be much stronger in the Dutch data. Recent cross-country evidence with Consensus Economics micro data on professional economists (Fendel et al., 2011) also point in the same direction. The interesting point for this study is the strong support found for a nonlinear Phillips curve.

Next, we use relationship [3] to estimate the (New Keynesian) Phillips curve. We use the survey values to examine whether the expected values reflect this basic relationship in the same way as the actual data (see e.g. Kortelainen et al., 2011a):

$$\Delta p^e_{it,\,T} = \alpha \Delta p^e_{it-1,\,T} + \beta \Delta p^e_{it,\,T+1} + \gamma \Delta y^e_{it,\,T} + \Sigma \text{Seas}_t + u_{it} \qquad [3]$$

where $\Delta y^e_{it,\,T}$ denotes the expected growth rate of output for the current calendar year expected in period *t* by forecaster *i*. *T* denotes the period to which the forecast applies. "Seas_i" with $i = 1, \ldots, 4$ is a seasonal dummy for quarter *i*. The equation was also estimated using fixed 4 quarters ahead expectations.[6] Equation [3] was estimated using both the ECB SPF and Consensus Forecast data (see the last seven rows in Table 3, and Table 4). The dependent variable is the forecast of current-period inflation. Hence it is in a sense the equivalent of real-time estimate of the current rate of inflation.

Table 4. **Relationship between US inflation and output growth forecasts in the CF survey**

Dep. var.	Const.	$\Delta y^e_{t,\,T}$	$\Delta y^e_{t,\,T+1}$	$\Delta p^e_{t,\,T+1}$	$\Delta p^e_{t-1,\,T}$	FE	Seas	R^2	SEE	X^2 test
$\Delta p^e_{t,\,T}$	2.617	0.032				x		0.963	0.222	784.4
	(57.12)	(1.74)								(0.00)
$\Delta p^e_{t,\,T+1}$	2.601		0.038			x		0.828	0.366	2 495
	(65.16)		(2.25)							(0.00)
$\Delta p^e_{t,\,T}$		0.149		0.855			x	0.464	0.835	599.17[a]
		(12.71)		(51.08)						(0.00)
$\Delta p^e_{t,\,T}$		0.053		0.138	0.851		x	0.828	0.389	130.08[a]
		(7.63)		(8.86)	(63.51)					(0.001)
$\Delta p^e_{t,\,T}$		0.043		0.283	0.684		x	0.824	0.478	161.46[a]
		(6.96)		(21.77)	(102.0)					(0.00)
$\Delta p^e_{t,\,T}$		0.062		0.264	0.684			0.815	0.492	320.60[a]
		(11.02)		(27.43)	(NA)					(0.00)
$\Delta y^e_{t,\,T+1}$	1.597	0.430				x		0.792	0.400	1 200
	(16.09)	(10.91)								(0.00)

Notes: Notation is the same as in Table 2. Superscript "*a*" denotes the case where the alternative is a model with forecaster-specific coefficients of the output growth variable. For equations in the fifth and sixth rows, actual past inflation is used instead of lagged value of expected current period inflation. In the latter equation, the coefficient of lagged inflation is allowed to be forecaster-specific. No fixed-effects are used with the Phillips curves. "FE" indicates that fixed cross-section effects and "seas" that seasonal dummies are included in the equation. X^2 test denotes the Chi-square test of equality of individual coefficients, or the test for fixed effects.

As for the Phillips curve, we find that a conventional hybrid specification performs strikingly well: the coefficients are correctly signed and of reasonable magnitude. This is not usually the case when a rational expectations model is estimated by GMM using lagged values of inflation and output as instruments.[7] The sum of coefficients of future and past inflation comes quite close to one in hybrid specification. The coefficients represent a not-so-new 50-50 split in weights between past and future inflation.[8]

If inflation expectations only partially reflect output growth expectations, we should consider other sources of differences in inflation expectations. The most obvious option is a difference in the Phillips curve parameters. Thus, we estimate Equation [2] with equal slopes for all forecasters and, alternatively, allowing for different (forecaster-specific) slopes. The corresponding test results for the hypothesis of equal coefficients for all forecasters are reported in the last column of Table 4. We see that the null hypothesis of equal coefficients is rejected, so that the slopes are indeed different (although only "marginally" in the hybrid specification), suggesting that the "forecasting model" may indeed also produce differences in inflation forecasts. Thus, differences in inflation forecasts may not simply reflect differences in the optimism-pessimism balance.

Finally, note that the estimates of the Phillips curve (rows 3-6 in Table 4) generally make sense; to some extent the results make more sense than those for the actual data as regards the imposition REH orthogonality conditions via the GMM estimator (see e.g. Adam and Padula, 2011). Thus, again the coefficient of output is positive and the coefficients for both the forward- and backward-looking inflation terms are of reasonable magnitude and the coefficients can be estimated quite precisely. This time, the coefficient of the lagged inflation term is much larger than that of the forward-looking term, probably reflecting the way in which the forecast value is constructed (i.e. using Equation [1]).

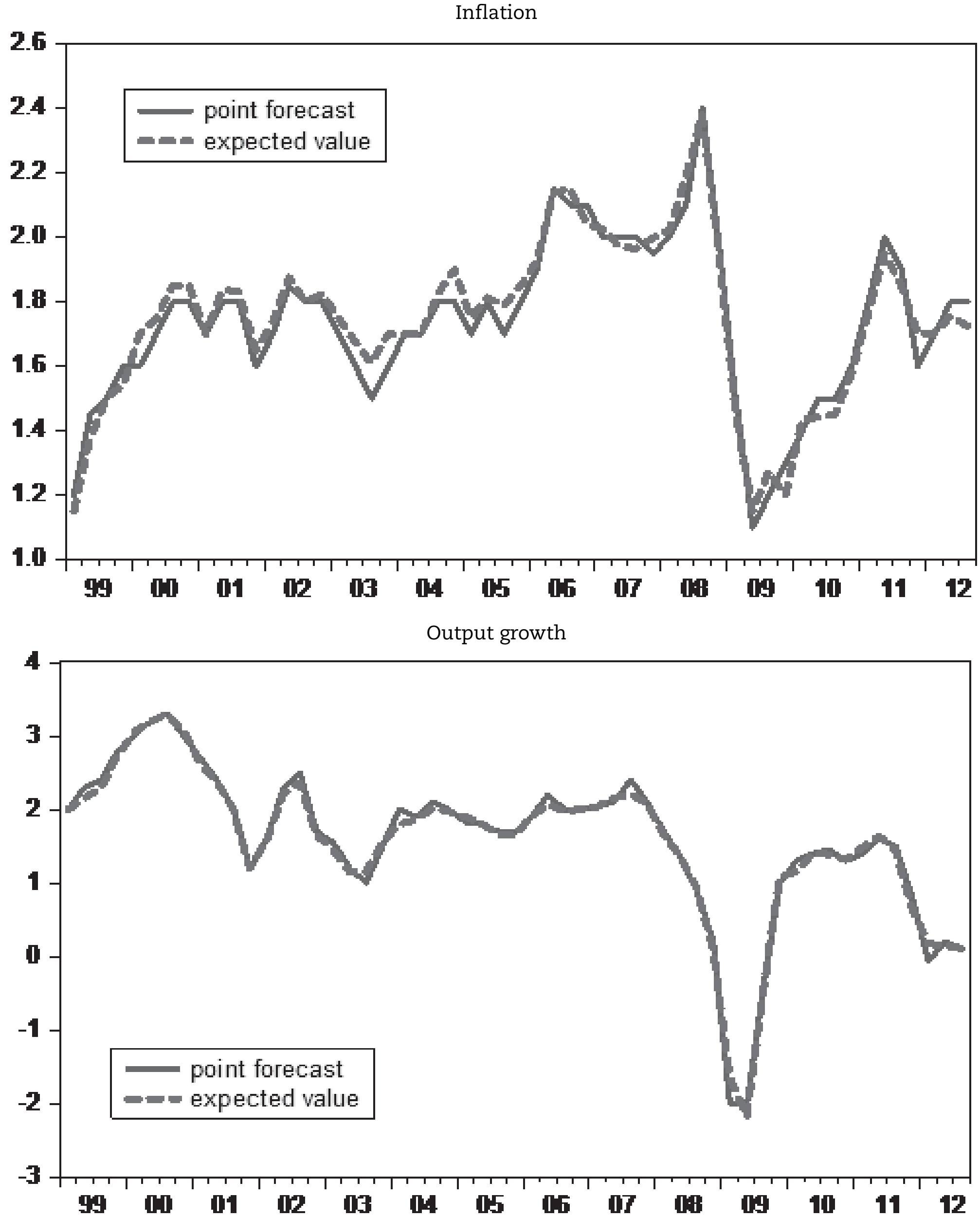
4. Analysis of forecast uncertainty

Finally, we turn to the analysis of forecast uncertainty and disagreement. The recent financial crisis clearly highlighted the fact that mean values of survey forecasts do not necessary reveal all relevant information about forecasters' expectations. An analysis of forecast uncertainty may also provide useful information on market participants' behaviour. Forecast uncertainty and disagreement in the ECB SPF survey has been analysed in some recent studies, but not in terms of view of internal consistency of different variables (see e.g. Bowles et al., 2010; and Conflitti, 2011). Uncertainty and disagreement in the Bank of England Survey of External Forecasters has been widely analysed in Boero et al. (2008).

The ECB SPF survey includes both individual point estimates and individual probability distributions (essentially for all forecast horizons). In Figure 4, we compare averages of individual point forecasts with corresponding expectations based on subjective probability distributions. Both inflation and real GDP growth forecasts for four quarters ahead are displayed. Figure 4 shows that the alternative forecast series are so closely related as to be almost identical, which suggests that forecasters use the point estimates as benchmarks for forming their subjective probability distributions.

Individual forecast uncertainty is investigated using two alternative measures: 1) the mean value of individual forecasters' subjective uncertainty, measured by the second moment of the distribution of forecast values; and 2) the conventional standard deviation of point forecasts, which measures disagreement between individual forecasters. Figure 5 represents these two measures for both inflation and output growth expectations four quarters ahead in the ECB SPF survey. The same information in a slightly different form and corresponding series for the US SPF survey are shown in Figure 7.

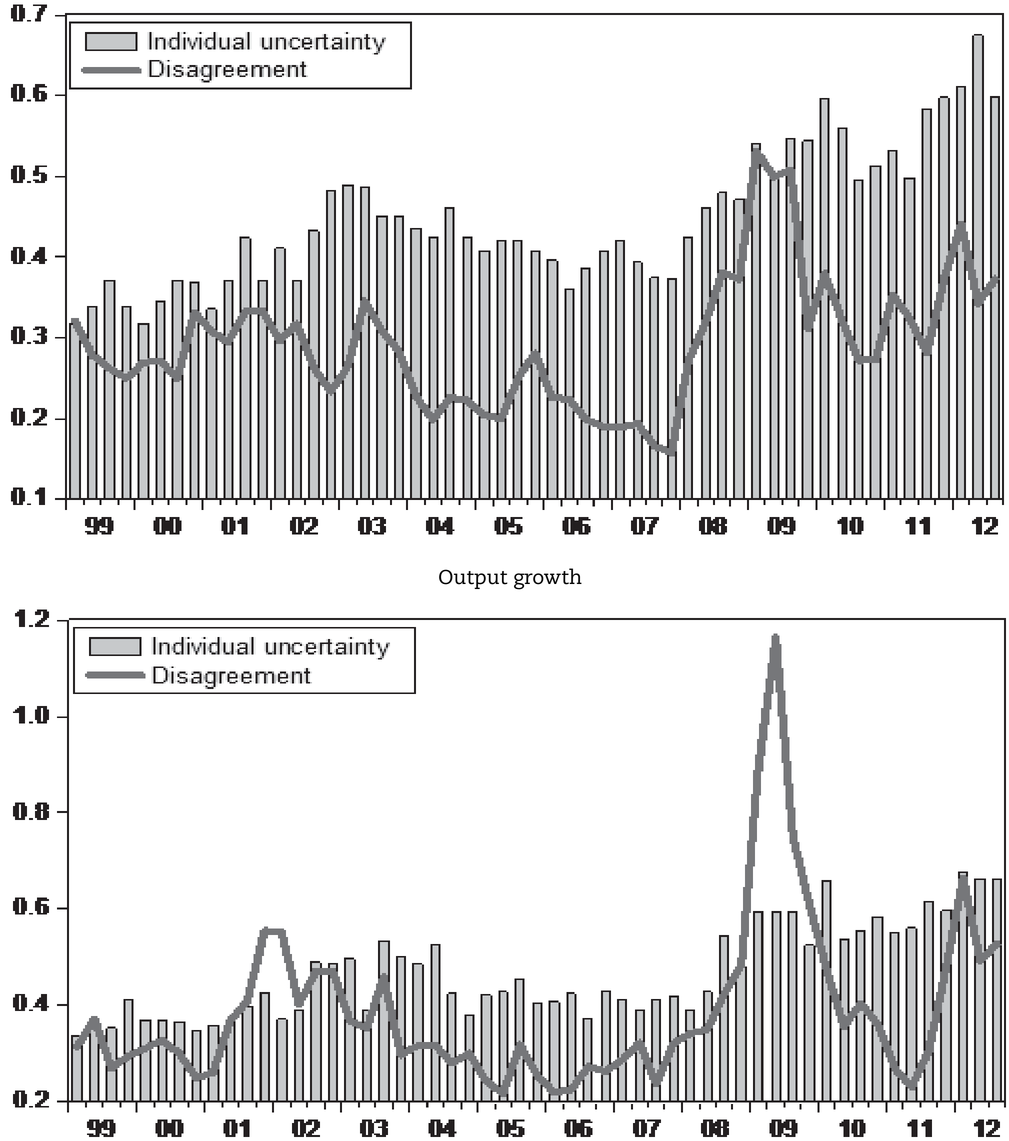
Figure 4. **Comparison of mean values of individual point forecasts and expected values based on subjective probability distributions (ECB SPF)**



Inflation disagreement and output growth disagreement are closely related (the correlation coefficient between these variables is 0.77, see Table 5). Moreover, they seem to be relatively closely related to forecast errors (absolute deviations between actual and expected values). By contrast, disagreement measures are only weakly (albeit statistically significantly) correlated with subjective uncertainty measures. Figure 5 provides at least a partial explanation. Forecast disagreement seems to have increased notably in response to the financial crisis.[9] The impact of the crisis on disagreement as to inflation expectations seems to be permanent while the impact on output growth disagreement has been more temporary. This is also the case for the "individual uncertainty" measure: the higher-than-normal levels of individual inflation uncertainty and output growth uncertainty have

Figure 5. **Disagreement vs. individual uncertainty (ECB SPF)**

Inflation



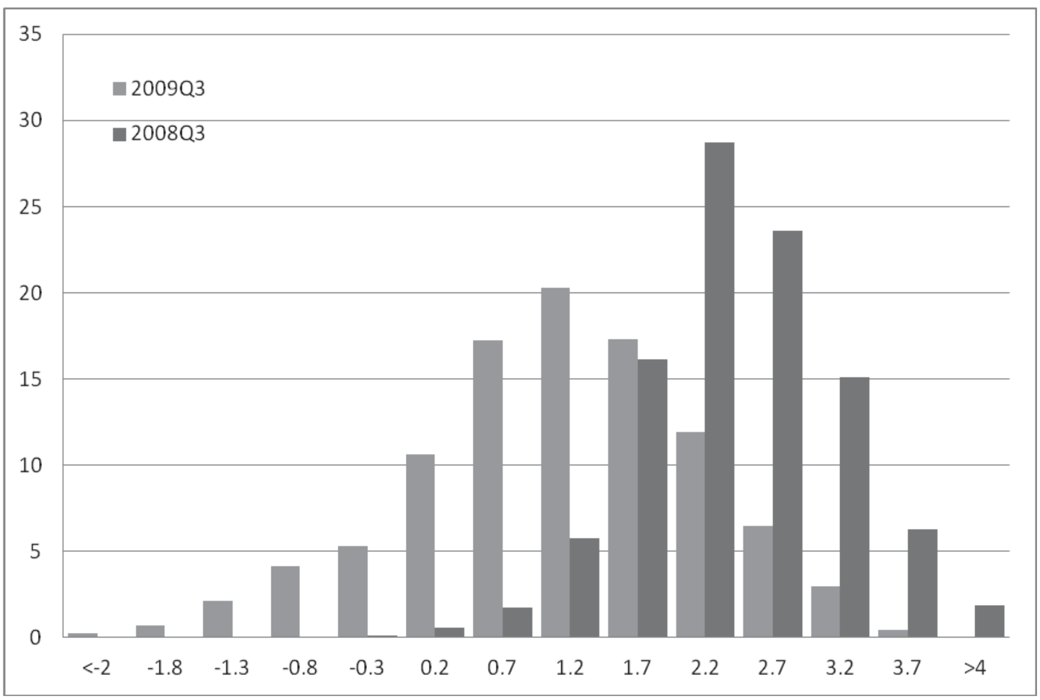
persisted since the peak of the financial crisis. It is worth noting that, compared to the pre-crisis period, individual point forecasts were highly divergent after mid-2008: in the middle of the crisis, both inflation and deflation were anticipated and similarly both positive and negative output growth values were forecasted. Therefore, increasing disagreement across forecasters may simply reflect increased polarisation of individual views, without any substantial change in individual uncertainties. Individual forecasters may still be very confident in their views even though they disagree with each other more than before. This "camp view" approach is introduced and tested e.g. by Geiger et al. (2009) and Andrade et al. (2012). Their results suggest that this possibility must be taken seriously in interpreting the uncertainty results.

Table 5. **Correlation coefficients between uncertainty measures in the ECB SPF survey**

	$\delta_{g,D}$	$\delta_{p,D}$	$\delta_{g,S}$	$\delta_{p,S}$	$\lvert\Delta y - \Delta y^e\rvert$	$\lvert\Delta p - \Delta p^e\rvert$
$\delta_{g,D}$	1.00	0.77	0.19	0.18	0.70	0.42
$\delta_{p,D}$	0.77	1.00	0.19	0.21	0.57	0.50
$\delta_{g,S}$	0.19	0.19	1.00	0.81	0.10	0.14
$\delta_{p,S}$	0.18	0.21	0.81	1.00	0.10	0.16
$\lvert\Delta y - \Delta y^e\rvert$	0.70	0.57	0.10	0.10	1.00	0.26
$\lvert\Delta p - \Delta p^e\rvert$	0.42	0.50	0.14	0.16	0.26	1.00

Notes: $\delta_{g,D}$ denotes the standard deviation of point estimates of output growth forecasts and $\delta_{g,S}$ the standard deviation of individual forecasters' forecast outcomes. $\lvert\Delta y - \Delta y^e\rvert$ refers to absolute forecast errors in terms of output growth. Subscript *p* refers to inflation forecasts. 5% significance level for correlations is 0.058.

Figure 6. **Average values of perceived probabilities of inflation expectations (ECB SPF)**



The ""camp view"" might also explain – at least partially – the puzzling features in Figure 5, in particular that the two uncertainty measures are only weakly related (and that the subjective uncertainty measures are only weakly related to the forecast errors; see Table 5).[10] Thus, one is well advised to interpret uncertainty developments in the aftermath of the crisis with caution and perhaps not to jump to the conclusion that the survey data tell us that inflation expectations have been firmly anchored in recent years.[11]

To get more insight into the nature of the change in subjective uncertainty we use the ECB SPF data to compare average probability distributions of individual forecasters for inflation expectations (computed four quarters ahead). We explore just two periods during the crisis: 2008Q3 and 2009Q3 (see Figure 6). The comparison indicates that the distributions are indeed quite different for the two periods. However, they are different largely because of the difference in means. A level shift in inflation expectations from 2008Q3 to 2009Q3 can be easily discerned, but the change in the dispersion is not equally obvious. Between the two periods the mean of variances computed from individual PDFs decreased from 12.2 to 9.6, but that mainly reflects the disappearance of the highest values for inflation expectations. Thus, it is questionable to claim that a genuine change in uncertainty (measured in this way) had taken place.[12]

Finally, we consider the GDP price index –based measures of inflation uncertainty in the US SPF survey since 1992Q1, shown in Figure 7.[13] The first panel illustrates mean expected inflation and corresponding minimum and maximum values for each period. Disagreement, i.e. standard deviation of point forecasts for four quarters ahead, is reported in the second panel. The graph of the series is quite reasonable during the crisis although the peak in the series is very short-lived and differs greatly from its European counterpart. Because the data seem to include several outliers, we focus not only on the standard deviation but also on the interquartile range (the difference between the 75th and 25th percentiles of the projections for Q/Q growth of the GDP price index, expressed in annualised percentage points). The corresponding series seem reasonable. However, we find relatively little systematic time-variation, so that this uncertainty measure is not very informative either.

The subjective uncertainty measure in Figure 7 is based on individual probabilities that in turn are related to the expected annual-average over annual-average percent change in the GDP price index.[14] The individual uncertainty has been surprisingly stable in the whole sample period. This can be partly explained by the chosen probability ranges in the survey (0 to 0.9, 1 to 1.9, 2 to 2.9, etc.). Since these ranges are relatively wide compared to the actual inflation history, there are typically only a few non-zero ranges in the survey responses. The time-variation in the response rate (last panel) may also explain why the subjective uncertainty measure for the US SPF survey is not very informative. The average number of non-zero entries per respondent is only 3.5, although the crisis increased the ratio somewhat (Figure 7). In the ECB SPF survey, things are somewhat better. With inflation, there has been 4.7 and with output growth 5.1 non-zero entries per respondent on average. However, this may simply reflect the clearly narrower probability ranges in the ECB questionnaire.

Examination of survey response patterns and survey response rates suggests that the higher-order moments of the data may not be very informative in assessing forecast uncertainty, even though there seem to be some indication of non-normal distributions. Take for instance the behaviour of maximum and minimum values *vis-à-vis* the expected inflation in the upper panel of Figure 7. The observed asymmetry may not reflect true changes in forecasting behaviour. The number of respondents is so small and the number of outliers so large that even the standard deviations may be on relatively shaky ground. That is a pity, because we would like to use the information on uncertainty proxies in evaluating the general public's perceptions on monetary policy.

Figure 7. **Different measures of inflation uncertainty in the US SPF survey**

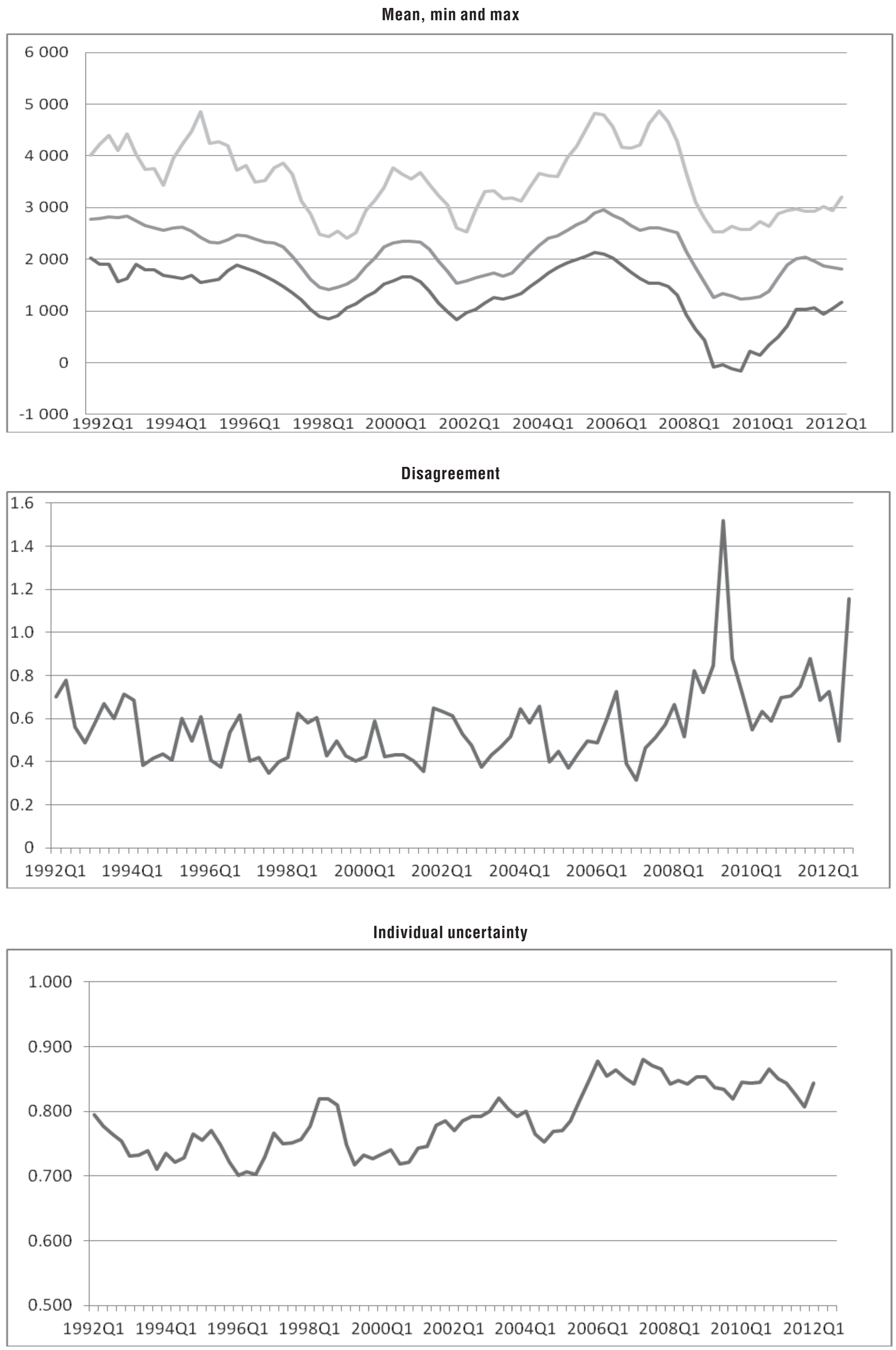
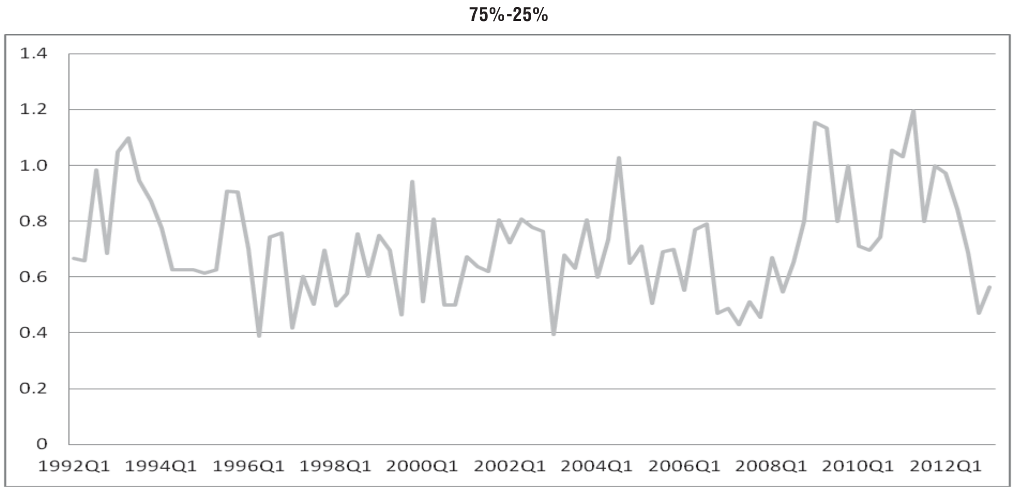
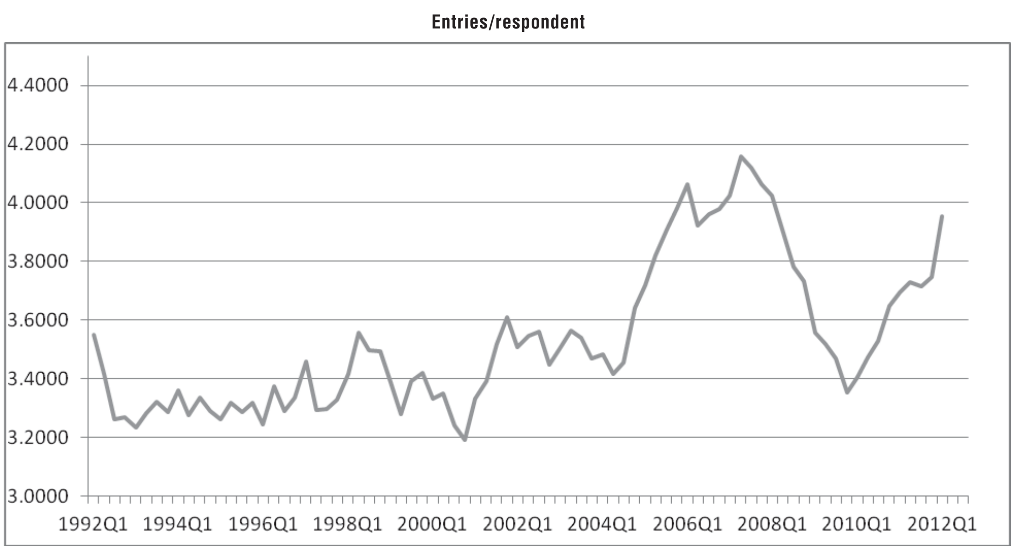


Figure 7. **Different measures of inflation uncertainty in the US SPF survey** *(cont.)*





Notes: The series "entries/respondent" are derived by dividing the total number of entries (categories in the distribution with non-zero values) by the number of forecasters. 75%-25 % is the Philadelphia FED measure of dispersion: the difference between the 75th percentile and 25th percentile (interquartile range) of the forecasts. It corresponds to our measure of disagreement, the cross-section standard deviation of point forecasts.

5. Concluding remarks

This paper has examined individual inflation and real GDP growth expectations using three alternative panel data sets. The analyses produced several interesting results. First of all, the results show that individual forecasters seem to deviate systematically from each other. Differences between individual forecasts are large and persistent, and individual views are more divergent for shorter forecast horizons. The results also indicate that basing forecasts on weighted averages of fixed event forecasts is not necessarily the optimal way to approximate fixed horizon forecasts.

The forecasters produce values that are largely consistent with basic principles of economics: inflation and output growth expectations are positively and significantly correlated and, moreover, consistent with the hybrid specification of the New Keynesian Phillips curve. This result is common for all data sets and data transformations. The slope parameters in the Phillips curve relationship seem not to be identical across individual forecasters, however, indicating that there is considerable amount of persistent heterogeneity across all forecasts. Finally, we find that individual inflation uncertainty based on subjective probability distributions is quite closely related to corresponding individual output uncertainty. However, the relationship between these uncertainty measures with corresponding standard deviations of individual point forecasts is relatively weak. To some extent, this can be explained by changes in the number of respondents and changes in probability ranges in the questionnaires. Also outliers play some role in this respect. Anyway, the respective uncertainties are positively (albeit more weakly) related.

Looking ahead, it would be very useful to explore micro data sets more extensively. One would then require more extensive data sets – more respondents and hopefully more detailed information in the questionnaire. Better information would facilitate more detailed examination of distributions and thus provide a more accurate measure of underlying forecasting uncertainty. Thus, for instance the so-called "twin peaks" hypothesis for different sets of forecasters could be tested. Additional data would also allow testing hypotheses that predict changes in inflation expectations on the basis of higher-order moments of the probability distribution of forecast values.

Notes

1. Kenny et al. (2012) provide some evidence of the usefulness of these data by showing that the distributional information helps to predict future inflation and output developments.
2. Schnader and Stekler (1991) and Kolb and Stekler (1996) in fact show that it is not clear whether we can simply use central moments, as we usually do, to characterise "consensus forecast".
3. Alternative data sets are summarised in Annex A.
4. The ECB SPF survey is described in detail in Bowles et al. (2007).
5. With the long time-horizon data we have a degrees-of-freedom problem (see Table 2) in that the results are not fully comparable with the shorter-time horizon data.
6. We have no monthly data on actual GDP growth, which would be needed to estimate the Phillips curve. Hence, we have to use some sort of "real time" proxy for current output. That is done by computing a 12-month moving average of expectations for current-year output growth (results reported in rows 3-6 of Table 4).
7. With the ECB SPF data we have a sort of seasonality problem due to the fact that the current values of inflation and output growth are expressed only in terms current calendar year.
8. Interpreting the results is problematic, because the forecasts do not appear to be unbiased. That is true both for inflation and output growth forecasts and for unbalanced and balanced panels. With output growth, the bias ($\Delta y^e{}_t - \Delta y_t$) is relatively small (0.19), but with inflation ($\Delta p^e{}_t - \Delta p_t$) it is more troublesome (-0.37).
9. This finding is consistent with Döpke and Fritsche (2006), who analysed forecast dispersion of German professional forecasts for 1970-2004. They find that forecast dispersion varies over time and is particularly high before and during recessions.
10. Unfortunately, we face a measurement problem here, because the ECB questionnaire was changed in 2008 to allow more negative values for inflation and output growth, which obviously affects the computed standard deviation. Careful scrutiny of the data however reveals that the new extreme values were used very often, so that the overall importance of the change is not devastating.
11. Typically, long-term forecast uncertainty is measured by standard deviations. Unfortunately, the sample size for long-term forecasts is so small as render problematic any proper statistical analysis.
12. The puzzling features of Figure 6 probably reflect the fact that the probability distributions of the questionnaire changed during the crisis. As a result of deteriorating growth and sharply decreasing

inflation, the scales in the questionnaire were changed substantially (more "extreme" alternatives were added).

13. Survey information is not fully comparable before and after 1992Q1 due to significant changes in the questionnaire. Here we focus only on inflation, but we would mention that in terms of uncertainty relationships inflation and output growth data follow the same pattern as in Europe. Thus, for instance, the correlation with the respective interquartile ranges was clearly positive, having a value of 0.38.

14. Due to changing forecast horizons in annual-average over annual-average series, we report here the moving averages.

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ANNEX A

Dataset details

ECB Survey of Professional Forecasters

Data source	European Central Bank, *www.ecb.europa.eu/stats/prices/indic/forecast/html/index.en.htm.*
Frequency	Quarterly.
Period	1999Q1-2012Q1.
Actual data	HICP and GDP growth rates over past 4 quarters from OECD.
Forecast variables for the euro area	HICP and real GDP forecasts for fixed calendar years ($T = t + 0$, $T = t + 1$, $T = t + 2$ or $T = t + L$, where L refers to longtterm) and for four, eight and 20 quarters ahead.

US SPF Survey of Professional Forecasts

Data source	Federal Reserve Bank of Philadelphia, *www.phil.frb.org/research-and-data/real-time-center/survey-of-professional-forecasters/*
Frequency	Quarterly.
Period	1992Q1-2012Q1.
Actual data	Growth rates of GDP price deflator over past 4 quarters from OECD.
Forecast variable for the US	Moving average of annual-average over annual-average of the GDP price deflator forecasts using Equation [1].

Consensus Forecasts

Data source	Consensus Economics, *www.consensuseconomics.com/con1/index.htm*
Frequency	Monthly.
Period	1988M1-2011M4.
Actual data	Growth rates of CPI and GDP over past 4 quarters from OECD.
Forecast variables for the US	CPI and real GDP forecasts based on Equation [1].