

Do Euro Area Forecasters (Still) Have Faith in Macroeconomic Building Blocks? – Expectation Formation when Economics is in Crisis

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Series in Economics

WP 09/03

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JEL classification: C32, F37, G15

Keywords: Macroeconomic Models, Forecasting, Euro Area

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We are grateful to Helge Berger, Jörg Breitung, Jordi Galí, Stuart Glosser, Thomas Laubach, Eric M. Leeper, Marcelo Sanchez, Jan-Egbert Sturm, participants of an internal seminar at the European Central Bank (ECB), of the 12th ZEI Summer School and of the euro area macroeconomic (EAM) seminar at the ECB for helpful suggestions and comments on an earlier draft of this paper. We are also very grateful to the EAM division of the ECB for providing the data set.

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1 Introduction

Since the early beginning of the financial and economic crisis in 2007, economists began to raise concerns about the usefulness of macroeconomic building blocks, because none of them had predicted the extent or even the occurrence of the financial and economic crisis of 2007-2009. In fact, it became conventional to blame macroeconomists for not anticipating such drastic events and it seems that even macroeconomists themselves lost faith in macroeconomic building blocks (De Grauwe 2009). As Lucas (2009) points out ‘Macroeconomists in particular were caricatured as a lost generation educated in the use of valueless, even harmful, mathematical models, an education that made them incapable of conducting sensible economic policy.’

As a consequence, some research institutes began to discontinue forecasting important macroeconomic variables in their large macroeconomic models (Fricke 2009). De Grauwe (2009) argues that the reason why most macroeconomic models have failed to predict the economic crisis is that they modeled the expectation formation process inappropriately. Most models are based on the assumption of rational expectations which is frequently rejected in empirical studies (Frankel and Froot 1987, Frankel and Rose 1995). Hence, the question arises how expectations are formed in the financial market. Therefore, this paper examines whether financial market participants (still) apply macroeconomic building blocks to predict real and financial variables and whether they discontinued to do so during the crisis. Hence, the analysis is to investigate the impact of the financial crisis on the expectations formation process.

The questions examined in this paper are relevant to academics, policy makers and financial market participants alike. Academics are typically interested to understand how expectations are built in financial markets in order to model financial market behavior. Policymakers find the analysis of expectations in financial markets appealing, because they use financial

market expectations to evaluate their policy actions (Berger et al. 2009).¹ Moreover, central banks influence market expectations through their policy actions (Gerberding et al. 2004).

In section 2, we describe the survey data used for our empirical research. In section 3, we lay out the macroeconomic building blocks and report our empirical findings. In section 4, we take a closer look at the question of whether the expectation formation process has changed during the crisis of 2007-2009. In section 5, we provide some concluding remarks.

2 Data

The paper uses the Survey of Professional Forecasters (SPF) which is conducted and compiled by the European Central Bank (ECB) and includes forecasts of financial market participants regarding several real and financial macroeconomic variables.² At the beginning of each quarter, the ECB asks professional forecasters about their projections of several financial and macroeconomic variables for the euro area. While the SPF includes forecasts for the unemployment rate, the harmonized index of consumer prices (HICP) and the real Gross Domestic Product (GDP) growth rate since 1999Q1, the forecasts of the ECB's interest rate for the main refinancing operations (wage growth rate) are published since 2002Q1 (2004Q3).³ As our data cover quarterly forecasts for the sample period from 1999Q1 to 2009Q2, it contains 42 periods. The forecasters participating in the survey work for institutions such as investment banks, large international corporations, economic research institutes, and at universities. A total of 108 forecasters participated in the

¹For instance, since central banks are aware that their policy actions affect real economic variables only with a certain time lag most central banks react to expectations rather than to current changes in macroeconomic variables.

²Thus, instead of directly asking financial market participants whether they adopt macroeconomic building blocks, we analyze their 'revealed believes' concerning the usefulness of several macroeconomic building blocks.

³Garcia (2003) provides a detailed description of the SPF data set.

survey. In order to investigate the time series characteristics of the expectation formation process of the participants, we only include professional forecasters who participated in the survey at least seven times between 1999Q1 and 2009Q2.⁴ This applies to a total of 92 participants and yields over 2,000 forecasts for the Consumer Price Index (*CPI*), the unemployment rate and the growth rate of the real *GDP*. For the interest rate (wage growth rate), the SPF contains more than 1,000 (500) observations.

The ECB asks the forecasters to predict the macroeconomic variables for different but fixed time horizons. While the real GDP growth rate, the inflation rate and the unemployment rate are predicted for the next twelve months and the next two years, the wage growth rate and the interest rate forecasts refer to the end of the next quarter and the next four quarters.⁵ Since the professional forecasters are requested to predict the variables for two different time horizons, we distinguish between a short-term and medium-term specification. The fixed time horizon has the advantage that the forecast accuracy is not improved by a diminishing time horizon. This makes the SPF a welcome database to examine the expectation formation process compared to other survey data with a time-varying forecast horizons, like the Consensus Economic Forecast or the Wall Street Journal poll.⁶

However, as we use up to eight-quarter-ahead forecasts which are published on a quarterly basis, our econometric analysis is impaired by the problem of overlapping forecast horizons. This obviously leads to serial correlation in the error terms by construction. In order to overcome the problem of serial correlation in the error terms due to overlapping forecast horizons, we apply the Newey-West panel estimator. This estimator allows us to consider

⁴Our results are robust using other minimum participation frequencies.

⁵The SPF also includes interest and wage growth forecasts for the end of the next two, three and five quarters. Using these forecast horizons do not change the results qualitatively which are available upon request.

⁶Fendel et al. (2009a,b) show how to deal with the survey structure of Consensus Economic Forecast and the Wall Street Journal poll.

a serial correlation structure in the errors up to the lag order of four and eight periods for the short-term and the medium-term forecasts, respectively.⁷ Hence, standard errors reported below are robust against heteroskedasticity, autocorrelation in the error terms and cross-section correlation.

Table 1 reports the average values of the expected macroeconomic variables for the short-term and medium-term forecast horizons as well as the actual average value for the respective variable. Over the full sample period, professional forecasters expect the inflation rate to be about 1.8 percent which is in line with the ECB's target rate and close to the actual average inflation rate of about 2 percent. For the other variables, the table displays that the values of the expected variables are close to the actual average values. Of course, this does not necessarily imply that the forecasters predict the macroeconomic variables accurately.⁸ Table 1 also reports the test statistic of the Pedroni panel unit root test (Pedroni 1999, 2004) with the null hypothesis of a unit root. The test indicates that all series are panel stationary which is a prerequisite to estimate our regression models properly in order to avoid the spurious regression problem (Österholm 2005).

– Include Table 1 about here –

To provide an impression of the time series characteristics, Figure 1 shows the actual interest rate (solid line), the mean of the one-quarter-ahead interest rate forecast (dotted line) and the range of the interest rate forecasts (shaded area). The Figure conveys the impression that the mean of the short-term interest rate forecast is close to the actual interest rate series indicating

⁷Standard autocorrelation tests indicate that this sufficiently captures the autocorrelation in the error term structure. However, applying different lag structures does not change our results qualitatively.

⁸Garcia and Manzanares (2007) and Bowles et al. (2009) analyze the forecast accuracy of the forecasters in the SPF. They find that individual point predictions tend to be biased towards favorable outcomes, i.e. forecasters predict too high growth rates and too low inflation rates.

a persistence in interest rate forecasts. Nevertheless, even in the period between 2003Q3 and 2005Q4 in which the ECB's interest rate remained stable at 2 percent, some economists expected interest rate changes. A fairly high degree of heterogeneity among the forecasters prevails also at other times; an extreme example is the last quarter of 2008, for which interest rate forecasts range from 2.5 to 4.5 percent. Figure 2 shows the individual short-term inflation forecasts. Similarly to the forecasts for the interest rate, the data depict a substantial degree for heterogeneity of inflation forecasts. For instance, in 2008Q4 the inflation forecasts vary between 0.4 and 2.6.

– Insert Figures 1 and 2 about here –

3 Is Expectation Formation based on Macroeconomic Building Blocks?

3.1 Empirical Methodology and Results of the Phillips Curve

In macroeconomics, the ‘wage Phillips curve’ captures the potentially important correlation between the growth rate of nominal wages and the unemployment rate. Phillips (1958) finds that rising wages tend to be correlated with a lower unemployment rate. This relationship can be expressed as:

$$\Delta w_t = \alpha_1 + \beta_1 u_t, \quad (1)$$

where Δw_t refers to the growth rate of nominal wages, u_t reflects the unemployment rate. Samuelson and Solow (1960) argue that the negative sign of β_1 is due to an increase in the bargaining power of workers in periods which reflect lower levels of unemployment. In such a situation it seems easier to increase wages. Hence, in order to analyze whether professional forecasters apply the wage Phillips curve, we derive the empirical counterpart of (1) which is given by

$$\mathbb{E}_{t,i} \Delta w_{t+k} = \alpha_{1,i} + \beta_1 \mathbb{E}_{t,i} u_{t+j} + \phi_{1,t} + \epsilon_{t,i}, \quad (2)$$

where $E_{t,i}$ denotes the forecast of forecaster i in quarter t for period $t + j$ ($t + k$) and $\phi_{1,t}$ is a time dummy for each quarter capturing time fixed effects. $\epsilon_{t,i}$ reflects a forecaster specific disturbance term and $\alpha_{1,i}$ represents the cross-section (forecasters) fixed effect so that equation (2) allows for unobserved heterogeneity. Henceforth, j (k) is 4 (1) and 8 (4) quarters for the short term and medium term, respectively.⁹ Samuelson and Solow (1960) modify the wage Phillips curve by assuming that companies incorporate a rise in nominal wages in their goods prices leading to an increase in the overall price level. The ‘price Phillips curve’ can be expressed as

$$\pi_t = \alpha_2 + \beta_2 u_t + \epsilon_t, \quad (3)$$

where π_t represents the current inflation rate and $\beta_2 < 0$ implies a negative correlation between the inflation rate and the unemployment rate. Similar to the wage Phillips curve, equation (3) can be transformed into the empirical counterpart of the price Phillips curve:

$$\mathbb{E}_{t,i}\pi_{t+j} = \alpha_{2,i} + \beta_2 \mathbb{E}_{t,i}u_{t+j} + \phi_{2,t} + \epsilon_{t,i}. \quad (4)$$

If forecasters’ expectations are consistent with the price Phillips curve, then $\beta_2 < 0$. Due to the time fixed effect specification ($\phi_{2,t}$), the magnitude and significance of the slope coefficient (β_2) is robust against any other specification of the Phillips curve that only adds a forecaster-constant term, e.g. the current inflation rate. Hence, equation (4) can easily be extended to a more recently developed Phillips curve where the change in the inflation rate and/or the change rather than the level of the unemployment rate enters equation (4).

⁹Due to data availability the wage Phillips curve is estimated in a forward-looking specification, i.e, the forecast horizon of the expected wage growth rate is lower compared to the expected unemployment rate.

Table 2 reports the regression results of equations (2) and (4) based on the Newey-West panel estimator for the short term and the medium term. The estimates suggest that euro area forecasters apply both the wage and the price Phillips curve since the estimates of both β_1 and β_2 are significantly negative. This applies to both time horizons. The estimation results for the wage Phillips curve with β_2 being $-.10$ (short-term specification) and $-.23$ (medium-term specification) indicate that forecasters believe in the negative trade-off between wage growth and unemployment. The short-term coefficient in the price Phillips curve of $-.27$ reflects that the forecasters – on average – believe that an increase in the unemployment rate by one percent is associated with a decrease in the inflation rate of about .27 percent.

An interesting feature of our empirical results is that the short-term coefficient of the wage Phillips curve of about $-.10$ is significantly smaller in absolute terms than the short-term coefficient of the price Phillips curve of about $-.27$. The reason might be that wages are less flexible compared to prices which would result in a flatter short-term wage Phillips curve. However, this argument does not apply for the medium-term β coefficients which are not statistically different from each other.

– Insert Table 2 about here –

3.2 Empirical Methodology and Results of Okun’s Law

Okun’s law measures the negative correlation between changes in the unemployment rate and the growth rate of real output (Okun 1962) and can be expressed as:

$$\Delta u_{t+1} = \alpha_3 + \beta_3 \Delta y_{t+1}, \quad (5)$$

where Δu_{t+1} denotes changes in the unemployment rate. Equation (5) is a widely used approximation of Okun’s law, built upon the assumptions that

both the natural rate of unemployment and the growth rate of potential output are constant. The empirical counterpart of equation (5) can be written as

$$\mathbb{E}_{t,i}\Delta u_{t+j} = \alpha_{3,i} + \beta_3\mathbb{E}_{t,i}\Delta y_{t+j} + \phi_{3,t} + \epsilon_{t,i}. \quad (6)$$

where Δu_{t+j} denotes the change in the unemployment rate in quarter $t+j$,¹⁰ Δy_{t+j} denotes the real growth rate. A positive value of the coefficient α_3 can be expected in countries in which the unemployment rate has increased over time. If forecasters' expectations are in line with Okun's law, one should observe a negative Okun coefficient, $\beta_3 < 0$. Based on *actual* changes in the unemployment rate and *actual* growth rates of real output for various countries, the empirical estimates of the Okun coefficient reported by Knoester (1986), Paldam (1987), Kaufman (1988), Moosa (1997), Lee (2000), Freeman (2001) and Sögner and Stiassny (2002) vary between -0.15 and -0.90 .¹¹

Table 2 also provides evidence that forecasters apply Okun's law. The Okun coefficient of $-.20$ for the short term implies that an increase in the expected real GDP growth rate of one percent is associated with a decrease in the expected unemployment rate of about .20 percent. This result holds also for the medium-term specification with a coefficient of about $-.30$ which exactly mirrors Okun's (1962) result.

¹⁰It is important to point out that we measure the unemployment rate relative to the real-time unemployment rate taken from the OECD database. As a robustness test, we replaced the real-time unemployment rate by the time-varying natural rate provided by the OECD and, alternatively, by the revised unemployment rate. The results of the robustness tests turned out to be qualitatively similar.

¹¹Okun (1962) found a value of β of about -0.30 , implying that an increase in the rate of unemployment leads to a more than proportionate change in output.

3.3 Empirical Methodology and Results for the Taylor Rule

Since the seminal paper of Taylor (1993), it has become virtually conventional to describe the interest rate setting behavior of central banks in terms of monetary policy reaction functions (Taylor 1999, Judd and Rudebusch 1998, and Clarida et al. 2000). Following Clarida et al. (1998, 2000) the baseline forward-looking policy rule takes the form:

$$i_t^* = \bar{i} + \beta_4 \mathbb{E}_t(\pi_{t+j} - \pi^*) + \gamma \mathbb{E}_t(y_{t+j} - y_{t+j}^*), \quad (7)$$

where i^* is the desired level of the nominal short-term interest rate, and \bar{i} is its equilibrium level. The second term on the right-hand side is the expected deviation of the j -period-ahead inflation rate (π) from the target rate (π^*) which is assumed to be constant over time. The third term is the expected deviation of the j -period-ahead level of output (y) from its natural level (y^*) (i.e., the output gap). The coefficients β_4 and γ represent the intensity with which the desired interest rate of the central bank reacts to the inflation and the output gap. The assumption of interest rate smoothing behavior then leads to:

$$i_t = (1 - \rho)i_t^* + \rho i_{t-1} + \nu_t, \quad (8)$$

where the parameter ρ (with $0 < \rho < 1$) describes the degree of interest rate smoothing and ν_t represents an i.i.d. exogenous random shock to the interest rate. Combining (7) and (8) leads to:

$$i_t = (1 - \rho)(\bar{i} + \beta_5 \mathbb{E}_t(\pi_{t+j} - \pi^*) + \gamma \mathbb{E}_t(y_{t+j} - y_{t+j}^*)) + \rho i_{t-1} + \nu_t \quad (9)$$

The most difficult variable to quantify in this framework is the expected output gap $\mathbb{E}_t(y_{t+j} - y_{t+j}^*)$, henceforth $\mathbb{E}_t(\tilde{y}_{t+j})$. To calculate the output trend y_{t+j}^* we apply a recursive Hodrick–Prescott filter (with the smoothing parameter set at $\lambda = 1,600$ which is common using quarterly data) and define the

expected output gap as $\mathbb{E}_t(\tilde{y}_{t+j}) = y_t \cdot [1 + \mathbb{E}_t(\Delta y_{t+j})] - y_{t+j}^*$.¹² We use the GDP of the euro area (y_t) and the expected growth rate $\mathbb{E}_t(\Delta y_{t+j})$ to calculate the expected GDP for the period $t + j$. Subtracting the GDP trend at period $t + j$ (y_{t+j}^*) yields the expected output gap $\mathbb{E}_t(\tilde{y}_{t+j})$.

In order to arrive at a testable relationship, the unobservable terms in equation (9) have to be eliminated. Since the SPF data allow us to directly observe expectations on the short-term interest rate, the inflation rate and output changes, we only lack information on the equilibrium interest rate and the inflation target of the respective central bank. Consistent with Clarida et al. (1998), we treat these two variables as time-invariant and aggregate both of them into the constant.¹³ Thus, we rewrite equation (9) as:

$$\mathbb{E}_{t,i}i_{t+k} = (1-\rho)\alpha_{4,i} + \beta_4(1-\rho)\mathbb{E}_{t,i}\pi_{t+j} + \gamma(1-\rho)\mathbb{E}_{t,i}(\tilde{y}_{t+j}) + \rho i_t + \phi_{4,t} + \epsilon_{t,i} \quad (10)$$

where

$$\alpha_{4,i} = \bar{i} - \beta_4\mathbb{E}\pi^*. \quad (11)$$

The short-term (medium-term) specification employs the one-quarter-ahead (one-year-ahead) interest rate forecast as the left-hand side variable, i.e. $k = 1$ (4), and, as the right hand side variable, one-year-ahead (two-years-ahead) forecasts for the GDP and inflation rate, i.e. $j = 4$ (8). This implies that the forecasters assume the transmission lag to be about three to four quarters. Taking into consideration that the time-lag of monetary policy

¹²Hence, the expected output gap consists of the observable output, the expected output change, and the output trend. Since information on current output is typically published with a certain time lag and sometimes revised, Orphanides (2001) uses real-time data, i.e. data available at the respective point in time. However, using real-time data from the OECD database does not change our results qualitatively (they are available upon request).

¹³Ireland (2007) and Leigh (2008) provide evidence that, the long-term inflation target of the Federal Reserve varies during the time period from 1950 to 2005. However, the ECB's has only a ten year recorded as Europe's monetary authority, we think that the assumption of a time-invariant long-term inflation rate is appropriate.

transmission is about nine to twelve months (Friedman, 1961), the forward-looking specification fits the central bank reaction function very well.

The outlined procedure allows us to investigate another feature inherent in the Taylor rule, i.e., the expected long-term inflation rate ($E\pi^*$). Equation (11) together with the Fisher relation

$$\bar{i} = i^{real} + \mathbb{E}\pi^* \quad (12)$$

yields

$$\alpha_{4,i} = i^{real} + (1 - \beta_4)\mathbb{E}\pi^*. \quad (13)$$

This implies that¹⁴

$$\mathbb{E}\pi^* = \frac{\alpha_{4,i} - i^{real}}{1 - \beta_4}. \quad (14)$$

Table 2 reports that forecasters believe that the ECB responds to the expected inflation rate and the expected output gap as proposed by the Taylor rule. The inflation coefficient (β_4) of about 1.71 is significantly positive and higher than unity indicating that the *Taylor principle* holds. This means that forecasters expect that the ECB responds to an increase in inflation expectations of one percent by raising the interest rate by about 1.7 percent indicating that the real interest rate increases by .7 percent. Using a similar procedure and estimating equation (10) with revised data for the period 1999 to 2003, Fendel and Frenkel (2005) report that the ECB's *actual* inflation coefficient is about 2.5 which is not significantly different from our estimate of 2.2 for the medium-term specification. Estimating equation (10) also yields an output gap coefficient of .05 (short-term specification) which reflects that forecasters expect the ECB to increase the interest rate by .05 if the expected output increases by one percent above the output trend.¹⁵ Based on *actual*

¹⁴Like Clarida et al. (1998), we define the real interest rate (i^{real}) as the nominal interest rate of about 2.86 (Table 1) minus the inflation rate of about 1.97 – which is 0.89.

¹⁵The positive output gap coefficient also applies if we only use the real growth forecast instead of the expected output gap. The results are available upon request.

data, Fendel and Frenkel (2005) estimate an output gap coefficient of about 0.2 which is larger than the value based on *expected* data. In sum, our findings provide strong evidence that professional forecasters apply the Taylor rule.

Based on the real interest rate and the estimates in Table 2, we can identify the expected long-term inflation rate ($E\pi^*$). Table 3 shows the real interest rate, the expected long-term inflation rate and the actual average inflation rate. In the short-term (medium-term) specification, the forecasters expect a long-term inflation rate of 2.43 (1.84) which is not significantly different from the actual inflation rate as indicated by the standard errors.¹⁶ This is also not different from the long-term inflation rates based on *actual* euro area data. Fendel and Frenkel (2005) report long-term inflation rates between 1.56 and 2.46 depending on the model specification.

– Insert Table 3 about here –

4 The Impact of the Economic Crisis on the Expectation Formation Process

This section analyzes whether the real and financial crisis which started in July 2007 has changed the expectation formation process in the euro area. To this end, we define a dummy (D_{crisis}) which is equal to one since 2007Q3 and zero otherwise.¹⁷ In order to examine whether professional forecasters changed their expectation formation process during the crisis, we interact the crisis dummy with the slope coefficient and estimate the model specifications discussed above. Hence, we test whether the expectation formation process

¹⁶The relatively low standard error in Table 3 indicates that the expected long-term inflation rate is constant over time rather than being time-varying.

¹⁷Defining the starting point of the economic crisis is somehow arbitrary since many events could have influenced expectations. Our choice of the 2007Q3 is based on the difficulties that investment and commercial banks, e.g. Bear Stearns, experienced in mid-2007. Subsequently, rating agencies downgraded several investment and commercial banks. As an alternative, we also looked at 2007Q4 as the starting point of the crisis but the results are qualitatively similar.

changed during the crisis compared to the pre-crisis period. We also test for a structural break in the constant term but we do not detect a break in the constant terms due to the crisis. This can be attributed to the time fixed effects dummy (ϕ) which captures systematic shocks to the expectation formation process. We estimate the equations of the macroeconomic building blocks including the crisis dummy (D_{crisis}) as follows:

Wage Phillips curve:

$$\mathbb{E}_{t,i}\Delta w_{t+k} = \alpha_{1,i} + \beta_1^{pre-crisis}\mathbb{E}_{t,i}u_{t+j} + \lambda_1\mathbb{E}_{t,i}u_{t+j} \cdot D_{crisis} + \phi_{1,t} + \epsilon_{t,i} \quad (15)$$

Price Phillips curve:

$$\mathbb{E}_{t,i}\pi_{t+j} = \alpha_{2,i} + \beta_2^{pre-crisis}\mathbb{E}_{t,i}u_{t+j} + \lambda_2\mathbb{E}_{t,i}u_{t+j} \cdot D_{crisis} + \phi_{2,t} + \epsilon_{t,i} \quad (16)$$

Okun's law:

$$\mathbb{E}_{t,i}\Delta u_{t+j} = \alpha_{3,i} + \beta_3^{pre-crisis}\mathbb{E}_{t,i}\Delta y_{t+j} + \lambda_3\mathbb{E}_{t,i}\Delta y_{t+j} \cdot D_{crisis} + \phi_{3,t} + \epsilon_{t,i} \quad (17)$$

Taylor rule:

$$\mathbb{E}_{t,i}i_{t+k} = (1-\rho)\alpha_{4,i} + \beta_4^{pre-crisis}(1-\rho)\mathbb{E}_{t,i}\pi_{t+j} + \gamma^{pre-crisis}(1-\rho)\mathbb{E}_{t,i}(\tilde{y}_{t+j}) \quad (18)$$

$$+ \lambda_4(1-\rho)\mathbb{E}_{t,i}\pi_{t+j} \cdot D_{crisis} + \lambda_5(1-\rho)\mathbb{E}_{t,i}(\tilde{y}_{t+j}) \cdot D_{crisis} + \rho i_t + \phi_{4,t} + \epsilon_{t,i}$$

The coefficient of the interaction term (λ_n) reflects the difference in the slope coefficient between the period before and during the crisis. From its size and significance together with the estimates of the pre-crisis slope coefficient we can infer the size and the significance of the 'new' coefficient (β_n^{crisis}).¹⁸

Table 4 reports the results of estimating equations (15), (16), (17), and (18). For the short-term wage and price Phillips curve, the negative

¹⁸For the Taylor Rule we also estimate interact the output gap with the crisis dummy to obtain a slope coefficient for the crisis γ^{crisis} .

relationship indicated by the β_n^{crisis} coefficients still prevails. Yet, the β_n^{crisis} is only statistically significant for the price Phillips curve implying that in times of crisis forecasters failed to believe in the short-term wage Phillips curve but still have strong faith in the relationship entailed in the short-term price Phillips curve. It seems that professional forecasters expect no changes in wage growth. The reason might be due to the fact that labor markets in the euro area are rigid resulting in a less flexible wage-setting behavior. By contrast, for the medium term the estimates of the Phillips curves indicate that professional forecasters expect a trade-off between wage growth or inflation and unemployment. The Okun coefficient is negative for the period before and during the crisis in both the short-term and medium-term specifications. Interestingly, the coefficients $\beta^{pre-crisis}$ and β^{crisis} are not different from each other for the price Phillips curve and Okun's law specifications. Obviously, the financial and economic crisis of 2007-2009 has not shattered forecasters' beliefs in macroeconomic building blocks.

Table 4 also shows the results of estimating the Taylor rule with the crisis dummy. The table supports our previous findings that, in general, forecasters believe in the Taylor principle and expect the ECB to respond to expected inflation and output changes for the full sample period. By contrast, during the crisis the inflation coefficients for the short and medium term (β_4^{crisis}) are not different from unity which violates the *Taylor principle*.¹⁹ This implies that forecasters do not expect the ECB to actively fight expected inflation during the crisis but rather to target probably a constant real interest rate. The loss of confidence in the inflation stabilization motive of the ECB is also reflected in the statistically significant coefficient of the interaction term between expected inflation and the crisis dummy (λ_4) for the short-term specification of about -1.53 . This implies that forecasters expect the ECB

¹⁹Davig and Leeper (2007) show that determinacy still prevails if the Taylor principle is violated for a short period of time. As long as there is substantial probability that an instable regime switches to a stable regime, the Taylor principle can be violated although determinacy is granted.

to respond less to the inflation rate compared to the full sample period. This means that the forecasters do not believe that the ECB applies the Taylor principle for its short-term and medium-term policy during the crisis.

– Insert Table 4 about here –

The results pass a number of robustness tests and diagnostic checks, including the application of real-time data²⁰ or replacing the point forecasts of the SPF participants by their probability forecasts. Garcia and Manzanares (2007) and Bowles et al. (2009) show that the SPF density forecasts are more reliable than the point forecasts. However, we use the point forecasts in our analysis since we do not investigate the accuracy of the SPF poll but rather the economic relationships underlying the forecasts.

5 Conclusion

Our empirical findings suggest that euro area forecasters believe in macroeconomic building blocks. Their forecasts are consistent with the concepts of the Phillips curve, Okun's law and the Taylor rule. This result passes a number of robustness tests (different forecast, different estimation techniques, and the application of real-time data). We also provide evidence that the economic crisis of 2007-2009 has not changed the expectation formation process as professional forecasters still adopt macroeconomic building blocks in order to make forecasts. In particular, in one area we find a clear effect of the crisis on the expectation formation process with respect to the Taylor rule: Forecasters do not expect the ECB to respond to inflation expectations during the crisis in a stabilizing way. Since the Taylor principle is not fulfilled in the expectation formation process during the crisis, the Taylor principle

²⁰More precisely, the results do not change qualitatively for the Phillips curve and Okun's law including the 'real-time' unemployment rate and inflation rate obtained from the OECD database. The results for the Taylor rule specification are robust using the 'real-time' GDP values. All results of the robustness tests are available upon request.

is violated. Our findings have interesting implications for monetary policy in the euro area. Apparently, the expectation forming process is well anchored in the euro area despite the economic crisis of 2007-2009. Hence, the ECB should not be concerned that interest rate expectations are delinked from inflation expectations, but rather the ECB should be aware that professional forecasters expect monetary policy to have effects on the real economy.

Additionally, the scepticism that was raised about macroeconomic building blocks during the financial and economic crisis 2007-2009 has not yet diffused into professional forecasts and probably will not do at all. Apparently, forecasters still think that, in the medium term, the monetary policy of the ECB is rule-based responding to expectations on inflation and real output changes. Moreover, professional forecasters still expect that monetary policy has effects on the real economy displayed by the trade-off relationship of the Phillips curve. Concluding, findings of our analysis suggest that professional forecasters still have faith in macroeconomic building blocks.

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Table 1: Forecasted and Actual Mean of Variables of the Data Set

Variable (Time Period)	Expected Value		Actual Value (Source)
	Short-Term	Medium-Term	
Inflation Rate (1999Q1 – 2009Q2)	1.77 [2.71]	1.82 [2.53]	1.97 (Eurostat)
GDP Growth (1999Q1 – 2009Q2)	1.82 [2.17]	2.24 [1.98]	2.08 (Eurostat)
Unemployment Rate (1999Q1 – 2009Q2)	8.45 [3.05]	8.20 [2.88]	8.49 (Eurostat)
Labor Costs (2004Q3 – 2009Q2)	2.43 [1.84]	2.52 [1.96]	2.58 (Eurostat)
Interest Rate (2002Q1 – 2009Q2)	2.78 [2.67]	3.00 [3.11]	2.86 (ECB)

Notes: Table 1 shows the expected and the actual mean of the variables over the sample period 1999Q1 (2002Q1/2004Q3) – 2009Q2; the values in squared brackets reflect t-values of the Pedroni panel unit root test under the null hypothesis of a unit root (Pedroni, 1999, 2004).

Table 2: Estimation Results for ‘Expected’ Macroeconomic Models

Model Horizon	Wage Phillips Curve ¹⁾		Price Phillips Curve ²⁾		Okuns Law ³⁾		Taylor Rule ⁴⁾	
	Short-Term	Medium-Term	Short-Term	Medium-Term	Short-Term	Medium-Term	Short-Term	Medium-Term
α_n	3.6308* (.23)	-1.1050 (.14)	4.2774* (.24)	2.8225* (.23)	.9071* (.13)	1.5847* (.18)	-.8231+ (.38)	-1.2924* (.49)
β_n	-1.020* (.03)	-.2302+ (.11)	-.2719* (.03)	-.0883* (.02)	-.2020* (.03)	-.3110* (.05)	1.7064* (.38)	2.1885* (.31)
γ	-	-	-	-	-	-	.0415* (.00)	.0681* (.02)
ρ	-	-	-	-	-	-	.8906* (.02)	.8628* (.04)
Observations (Groups)	657 (67)	226 (45)	2008 (91)	1803 (90)	2013 (87)	1810 (86)	1292 (77)	1010 (68)
Cross-section FE (F-value)	45.08*	1.70*	18.90*	28.22*	5.42*	24.35*	46.46*	1424.57*
Time FE (F-value)	14.76*	12.11*	7.97*	2.70*	91.06*	30.21*	44.76*	32.08*
Adj. R ²	.3881	.6133	.4566	.3283	.7436	.6177	.9819	.8854

Notes: ¹⁾ Equation (2); ²⁾ Equation (4); ³⁾ Equation (6); ⁴⁾ Equation (10); Robust Newey-West standard errors in parentheses; * (+) indicates significance at the one (ten) percent level, respectively; For the fixed effects (FE) we report the ‘F-value’.

Table 3: Expected Long-Term Inflation Rate and Actual Inflation Rate

	Short-Term	Medium-Term
Real Interest Rate (i^{real})	.89	.89
Expected Long-Term Inflation Rate ($E\pi^*$)	2.43* (.84)	1.84* (.25)
Actual Inflation Rate (π^{act})	1.97	1.97
Test: $E\pi^* = \pi^{act}$.58	.59

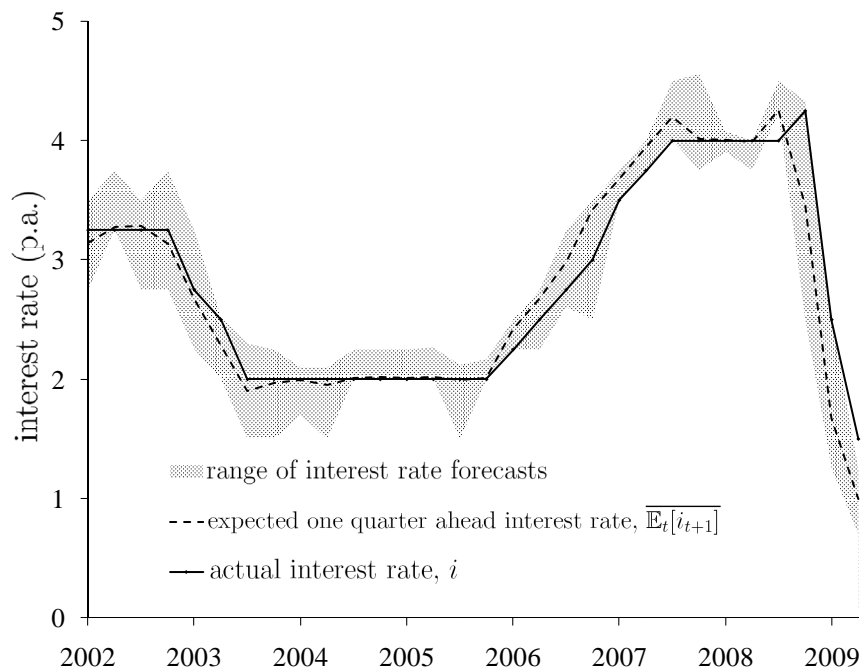
Notes: The real interest rate is the difference between the average interest rate and the average inflation rate of the period 1999 – 2009 as reported in Table 1; the expected inflation rate is calculated by the means of equation (10) $E\pi^* = \frac{\alpha_4 - i^{real}}{1 - \beta_4}$ based on the estimation results of Table 2; ; robust Newey-West standard errors in parentheses; the actual inflation rate π^{act} reflects the average inflation rate as displayed in Table 1; the last row reflects the significance level of a two-sided t-test under the null hypothesis that the expected long-term inflation rate equals the actual average inflation rate.

Table 4: Estimation Results for ‘Expected’ Macroeconomic Models with Crisis Dummy

Model Horizon	Wage Phillips Curve ¹⁾		Price Phillips Curve ²⁾		Okuns Law ³⁾		Taylor Rule ⁴⁾	
	Short-Term	Medium-Term	Short-Term	Medium-Term	Short-Term	Medium-Term	Short-Term	Medium-Term
α_n	3.3531* (.37)	-.0949 (.14)	4.1195* (.19)	2.8626* (.39)	.8942* (.18)	1.5834* (.21)	-2.3370* (.82)	-1.3370 (1.05)
$\beta_n^{pre-crisis}$	-.0736* (.03)	-.0836 (.22)	-.2650* (.02)	-.0861* (.03)	-.1971* (.02)	-.3116* (.05)	2.6609* (.84)	2.1249* (.15)
β_n^{crisis}	-.0494 (.04)	-.2699* (.12)	-.2562* (.02)	-.0922* (.02)	-.2086* (.06)	-.3096* (.11)	1.1345* (.34)	1.9869* (.91)
$\gamma^{pre-crisis}$	—	—	—	—	—	—	.0751* (.01)	.0246* (.01)
γ^{crisis}	—	—	—	—	—	—	.0781* (.02)	.0676* (.02)
ρ	—	—	—	—	—	—	.9181* (.02)	.7978* (.03)
λ_n	.0242* (.01)	-.1863 (.25)	.0088 (.01)	-.0061 (.05)	-.0115 (.06)	-.0020 (.12)	-1.5264* (.56)	-1.380 (.90)
Observations (Groups)	657 (67)	226 (45)	2008 (91)	1803 (90)	2013 (87)	1810 (86)	1292 (77)	1010 (68)
Cross-section FE (F-value)	143.77*	1.69*	20.24*	26.83*	5.19*	24.65*	34.46*	22.90*
Time FE (F-value)	16.90*	2.76*	6.24*	2.70*	80.97*	31.19*	38.36*	26.61*
overall R ²	.4025	.6172	.5099	.3279	.7435	.6372	.9798	.8857

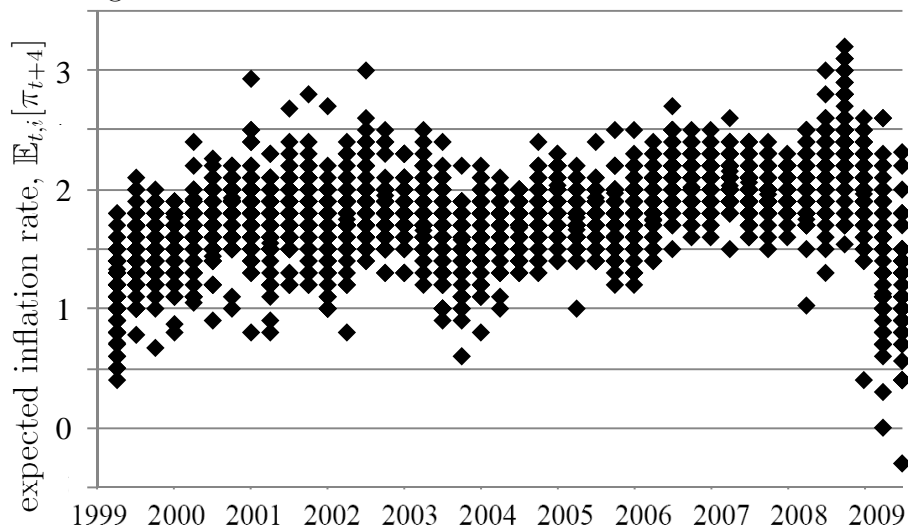
Notes: 1) Equation (15); 2) Based on equation (16); 3) Equation (17); 4) Equation (18); Robust Newey-West standard errors in parentheses; * (+) indicates significance at the one (ten) percent level, respectively; For the fixed effects (FE) we report the ‘F-value’ R² reflects the overall R² obtained from a fixed effect OLS regression.

Figure 1: Expected and Actual Interest Rate and Inflation Rate



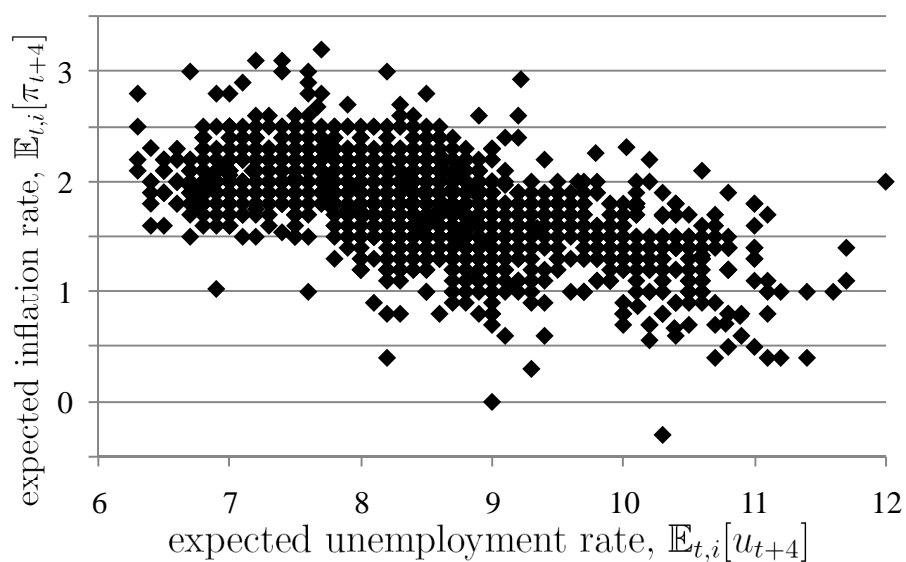
Note: The solid (dotted) line represents the actual (expected) interest rate, while the shaded area reflects the range of interest rate forecasts as of the time of the forecast.

Figure 2: Individual One-Year-Ahead Inflation Forecasts



Note: The points reflect individual one-year-ahead forecasts of the harmonized index of consumer prices (HICP) for the euro area at the time of the forecast.

Figure 3: Expected Price Phillips Curve



Note: The points reflect individual inflation forecasts (horizontal axis) and unemployment forecasts (vertical axis) for the current year; a regression line yields $E_t[\widehat{\pi_{t+j,i}}] = 4.27 - 0.27 E_t[\widehat{u_{t+j,i}}] + \widehat{\epsilon}$ with an adjusted R^2 of 0.46 as indicated in Table 2.