

## Inflation expectations in Spain: The Spanish PwC Survey

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**Abstract:** We examine the predictive ability, the consistency properties and the possible driving forces of inflation expectations, using a survey conducted in Spain by PwC among a panel of experts and entrepreneurs. When analysing the headline inflation rate, our results suggest that the PwC panel has some forecasting ability for time horizons from 3 to 9, improving when it comes to predict the core inflation rate. Nevertheless, the results indicate that predictions made by survey participants are neither unbiased nor efficient predictors of future inflation rates, regardless of the measures of inflation used. As for the consistency properties of the inflation expectations formation process, we find that panel members form stabilising expectations in the case of the headline inflation rate, both in the short and in the long-run, although in the case of the core inflation rate, consistency remains indeterminate. Finally, we find that inflation expectations are very persistent and that they appear to incorporate the information content of some macroeconomic variables (current core inflation and growth rate, the USD/EUR exchange rate, the ECB inflation target and changes in the ECB official short-term interest rate).

**Keywords:** Inflation, Forecasting, Expectations, Panel data, Econometric models.

**JEL classification:** E31, D84, C33

## **Inflation rate expectations in Spain: The Spanish PwC Survey**

### **1. INTRODUCTION**

Inflation expectations are at the centre of modern macro-economic theory and monetary policy (see, e. g., Gali, 2008, and Sims, 2009). Virtually all macro-economic models are built on the assumption that agents maximize expected utility under a well defined distribution representing their inflation beliefs. In addition, inflation expectations are used by central banks to gain an insight into the private sector's assessment of the outlook for future inflation and to evaluate perceptions about the credibility of monetary policy<sup>1</sup>.

Despite its prominence and the ample use there is only scarce evidence about how people form their expectations and why they disagree. The basic problem of the expectations approach to forecasting is how to uncover market participants' expectations, since this variable is in fact latent (it cannot be directly observed). Existing measures of inflation expectations may be partitioned into two broad categories depending on whether they are direct or indirect. Indirect measures are inferred from either financial instruments (such as the Treasury Inflation-Protected Security), the term structure of interest rates, or past realizations of inflations rates. Direct methods of measuring expectations typically rely on some sort of survey in which certain subsamples of the population are asked to reveal their personal expectations.

Empirical studies often show that inflation forecasts of professional economists influence expectations of those agents who are not experienced in macroeconomic forecasts (e.g. Carroll 2003; Döepke et al. 2008). Though the rationality of survey forecasts has been debated (Croushore, 1998), they are generally well regarded, especially the forecasts made by the professionals. Indeed, there is some empirical evidence suggesting that median responses generally track official estimates of realized inflation, sometimes even outperforming professional forecasters (see, Hafer and Hein, 1985; Thomas, 1999, and Ang *et al.*, 2007, among others). Ang *et al.* (2007) argue that the superior performance of survey forecasts could be related to the fact that the

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<sup>1</sup> Bernanke *et al.* (2001) discuss how the behaviour of survey forecasts relative to the central bank's inflation target provides information about credibility.

surveys simply aggregate information from many different sources, not captured by a single model.

In this paper, we examine the predictive ability and consistency of expectations about the inflation rate based on the quarterly survey conducted by the Spanish branch of PricewaterhouseCoopers (PwC), as well as the possible driving forces behind the expectation formation process. Our sample consists of thirty surveys covering the period from the second quarter of 2003 to the third quarter of 2011.

The paper is organised as follows. Section 2 describes the data. In Section 3 the forecast accuracy of the survey is assessed. Section 4 examines the consistency properties of the inflation rate expectation formation process of short and long forecasts. In Section 5 we explore the role of potential determinants in explaining the expectation formation process revealed by the panel. Finally, in Section 6 some concluding remarks are offered.

## **2. THE SURVEY DATA**

Since 1999, the Spanish branch of PwC has been conducting a quarterly survey on the Spanish economic situation. One of the questions refers to inflation rate expectations. Survey participants are asked the last week prior to quarter's end to deliver three and nine- month-ahead expectations or six and twelve- month-ahead expectations of the inflation rate. The dates when the surveys were conducted have been recorded. We have included in the data set the observed, 3-, 6-, 9-, and 12-month ahead inflation rates computing from the overall Consumer Price Index (CPI), taking from the Instituto Nacional de Estadística (INE).

The PwC survey is based upon the opinion of panel of experts and entrepreneurs. The panel members cover the following sectors: non-financial corporations (an average of 32.22 percent of respondents), universities and economic research centres (24.26 percent), financial system (21.48 percent), business and professional associations (17.31 percent) and institutions (4.65 percent). The number of participants of the survey varies

from 95 in the third quarter of 2009 to 156 in the fourth quarter of 2004, being 118 the average number of participants.

One important feature of the Spanish PwC panel is anonymity of forecasters. Although the names of the panel participants are provided for each survey, it is not possible to know the answers of each person, so the researcher cannot follow the forecasts of a particular panel member over time. Nevertheless, this anonymity could encourage people to provide their best forecasts, without fearing the consequences of making forecast errors.

We concentrate in the 3-, 6-, 9- and 12-month ahead forecasts, using 30 of the 33 surveys available<sup>2</sup>. On average, the number of survey participants who responded to our question of interest was 115, reaching its minimum and maximum in the third quarter of 2009 to fourth quarter 2004 with 90 and 154 people, respectively.

### **3. FORECAST ACCURACY**

We initially evaluated the forecasting performance of the PwC panel in explaining headline inflation using the root mean square error (RMSE) and the Theil inequality coefficient. Additionally, we also consider the decomposition of the mean squared forecast error in its bias, variance and covariance proportions in order to assess, respectively, how far the mean of the forecast is from the mean of the actual series, how far the variation of the forecast is from the variation of the actual series, and how large is the remaining unsystematic forecasting errors.

Panel A in Table 1 shows the forecasting performance of our panel in tracking evolution of the overall CPI for 3-, 6-, 9- and 12-month ahead. As can be seen, the RMSE is large and increases with the forecast horizon what it means that forecasters have made mistakes in their predictions and make it worse as we move away from the temporal horizon. This result is reinforced regarding the Theil inequality coefficient, since it is not closer to zero. As for the bias proportion, since it is always zero, it suggests no

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<sup>2</sup> We do not have enough information for the question of the inflation rate for the surveys corresponding to the third quarter of 2007, the first quarter of 2008 and finally the third quarter of 2010.

systematic error in the forecasts of the PwC panel. The estimated variance proportion indicates a notable ability of the forecasts to replicate the degree of variability in the inflation rate, at least for the horizons  $k=3$  and 6. For these forecasting horizons, the bias and variance proportions are small so that most of the bias is concentrated on the covariance proportions (i.e., in the unsystematic error). In other words, the mistakes made by panel members are not deterministic, in particular, the deviation of inflation rate prediction with respect to the actual value is random.

**Table 1: Forecast accuracy**

<b>Panel A: Headline inflation</b>					
	RMSE	Theil inequality coefficient	Bias proportion	Variance proportion	Covariance proportion
3-month ahead	0.972937	0.166897	0.004262	0.063673	0.932064
6-month ahead	1.054963	0.197166	0.063899	0.011847	0.924255
9-month ahead	1.579039	0.290485	0.023790	0.141639	0.834571
12-month ahead	1.703497	0.310188	0.045373	0.089201	0.865427
<b>Panel B: Core inflation</b>					
	RMSE	Theil inequality coefficient	Bias proportion	Variance proportion	Covariance proportion
3-month ahead	0.565846	0.117376	0.015627	0.000036	0.984336
6-month ahead	0.538645	0.118828	0.016251	0.000012	0.983737
9-month ahead	0.830764	0.183802	0.005659	0.098943	0.895398
12-month ahead	0.903056	0.201881	0.017680	0.048886	0.933434

To assess if the PwC panel is able to predict more accurately than a random walk the direction of headline inflation movements, we have also computed the percentage of correct predictions. As can be seen in Panel A of Table 2, predictions as to whether the headline inflation rate will increase or decrease for every forecast period, they show nearly 60% of successes for  $k=3$  and 9 and surpassing for  $k=6, 12$ . Therefore, panel forecasts clearly outperforming the random walk directional forecasts in all horizons.

**Table 2: Directional forecast**

<b>Panel A: Headline inflation</b>	
3-month ahead	58.82
6-month ahead	61.54
9-month ahead	58.82
12-month ahead	61.54
<b>Panel B: Core inflation</b>	
3-month ahead	82.35
6-month ahead	76.92
9-month ahead	76.47
12-month ahead	76.92

Therefore, the evidence presented in Panels A of Tables 1 and 2 suggests that the PwC panel has some forecasting ability in tracking the evolution of the headline inflation in Spain, at least until 9-month ahead.

Blinder and Reis (2005) argue that it is better to predict headline inflation using lagged core (rather than headline) inflation. To explore the possibility that the participants in the PwC panel could be paying less attention to headline inflation data but they could be still relying heavily on core inflation data, we have assessed the forecast accuracy and the directional forecast behaviour of the inflation expectations when forecasting core inflation. Panel B in Tables 1 and 2 show the results.

As can be seen, there is a general improvement in both the RMSE statistic, the Theil inequality coefficient and in the directional forecasts. Surprisingly, forecasts of headline inflation are rather good forecasts of core inflation. Therefore, our results seem to suggest that the panel participants may be implicitly forecasting the core inflation rate, instead of the headline inflation rate (which is what they are asked to forecast).

As a further assessment of the accuracy of the forecasts made by the PwC panel, we test the hypothesis that the panel forecasts are optimal predictors of future inflation rates. If the forecasts made by panel participants are unbiased and efficient predictors of the future inflation rate, a regression of the observed inflation rate at time  $t+k$  ( $\pi_{t+k}$ ) on the expected rate determined at time  $t$  for  $k$ -periods ahead ( $\pi_{t+k}^e$ ).

$$\pi_{t+k} = \alpha + \beta \pi_{t+k}^e + \varepsilon_{t+k} \quad (1)$$

should result in a estimated constant ( $\hat{\alpha}$ ) not significantly different from zero and an estimated coefficient on the expected rate ( $\hat{\beta}$ ) not significantly different from one. Table 3 presents the estimation results and the Wald test on the joint hypothesis:  $H_0 : \hat{\alpha} = 0, \hat{\beta} = 1$ . Moreover, Grant and Thomas (1999) contend that this hypothesis can be used to verify the existence of “weak form of rationality” since the rational expectations hypothesis does not require the forecasts to be strictly correct in all periods but, instead, requires the forecast errors to be unbiased and uncorrelated with any information in which the forecast is conditioned (see Clements, 2005).

**Table 3: Forecast optimality**

<b>Panel A: Headline inflation</b>				
	3-month ahead	6-month ahead	9-month ahead	12-month ahead
$\hat{\alpha}$	0.612682 (0.0000)	1.906420 (0.0000)	2.535416 (0.0000)	3.452318 (0.0000)
$\hat{\beta}$	0.754766 (0.0000)	0.299054 (0.0000)	0.044489 (0.1611)	-0.258337 (0.0000)
Prob(F-statistic)	0.0000	0.0000	0.161124	0.0000
Wald F-test	86.34462 (0.0000)	744.6454 (0.0000)	454.0752 (0.0000)	700.3444 (0.0000)
No. of observations	1937	1504	1937	1504
<b>Panel B: Core inflation</b>				
	3-month ahead	6-month ahead	9-month ahead	12-month ahead
$\hat{\alpha}$	0.691741 (0.0000)	0.700064 (0.0000)	1.030993 (0.0000)	1.458905 (0.0000)
$\hat{\beta}$	0.586298 (0.0000)	0.565421 (0.0000)	0.429859 (0.0000)	0.297322 (0.0000)
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000
Wald F-test	1272.243 (0.0000)	1104.672 (0.0000)	798.0567 (0.0000)	632.5904 (0.0000)
No. of observations	1937	1504	1937	1504

Notes: p-values in parenthesis

As can be seen, the results suggest that we can decisively reject the null hypothesis for all forecast horizons, indicating that such forecasts are biased and not efficient predictors of the future inflation rate, regardless the inflation measures (headline or core inflation) used as observed inflation rate. Therefore, our results support a “weak form of rationality” for the PwC panel base-inflation expectations, partially reflecting the degree of sophistication of the models and frameworks used by the Spanish market agents when forming their inflation expectations.

#### 4. EXPECTATION CONSISTENCY

According to Froot and Ito (1989), consistency of expectations formed at the same point in time prevails if expectations about inflation rate changes during subsequent shorter time periods and expectations about the inflation rate for the entire time period give the same result. Note that consistency is a necessary condition if expectations are to be

rational, but is weaker than rationality since it does not require that the expectation process match the stochastic process generating actual inflation rates.

Following Frankel and Froot (1987a, b) and Frenkel and Rülke (2011), we assume that inflation rate forecasters build their expectations by using an extrapolative model which can, in its simplest form, be expressed as a distributed lag function with one lag:

$$E_{t,i}(\pi_{t+k}) - \pi_t = \alpha_k + \beta_k(\pi_{t-1} - \pi_t) + \varepsilon_{t,i} \quad (2)$$

where  $\pi_t$  and  $E_{t,i}(\pi_{t+k})$  denote, respectively, the inflation rate at  $t$  and the expected inflation rate for  $t+k$  of forecaster  $i$  at time  $t$ . Subscript  $k$  denotes the forecast horizon and  $\varepsilon$  the error term.

A positive  $\beta_k$  indicates that with a slowdown in price growth during the period preceding the time of the forecast leads panel members to expect an opposite effect for the next period. Therefore they will expect that the inflation rate in  $t+k$  exceeds  $t$ , expectations being in this case stabilising. On the contrary, if  $\beta_k$  is negative and in the preceding period forecasters observe that the rate at which prices grow is less, then they expect that the inflation rate in  $t+k$  is less than  $t$ , expectations being in this case destabilising.

Note that in our survey data gathers the participants' expectations at different horizons at the same point of time, being the information set available to the agent the same, therefore allowing us to formally estimate (2) for such forecasting horizons. Table 4 reports the results. As can be seen in Panel A, the short-run  $\beta_k$  and the long-run  $\beta_k$  are positive for both time horizons (3 and 9 months and 6 and 12 months), indicating that survey participants form stabilising expectations in the short-run and in the long-run when forecasting headline inflation. This result suggests that we should not reject the null hypothesis that short-run forecasts are consistent with long-run forecasts. As for the forecasting of core inflation, results in Panel B. In this case, the estimated betas do not coincide in sign either in the short or in the long term. Regarding the long term, on the one hand, facing a reduction in the core inflation rate, the PwC panel expects a higher core inflation rate nine months later compared with the current rate (since the estimated



beta is positive). On the other hand, if the panel participants observe that the core inflation rate in the month of the survey is lower than that in the previous month, they predict that this reduction will be further strengthened after twelve months, being therefore destabilising expectations. While consistency is indeterminate in the long run, the situation does not change when we focus on the short term. The reason is that facing a reduction in the inflation rate, the PwC panel forms destabilising expectations and, although the estimated beta for  $k = 3$  also appears with a negative sign, it is not statistically significant and, after taking the constant out of the regression, the estimated beta experiences a change of sign, implying stabilising expectations.

**Table 4: Expectation formation processes**

<b>Panel A: Headline inflation</b>				
	3-month ahead	9-month ahead	6-month ahead	12-month ahead
$\hat{\alpha}$	-0.143692 (0.0000)	-0.193739 (0.0000)	-0.157764 (0.0000)	-0.250228 (0.0000)
$\hat{\beta}$	0.919159 (0.0000)	0.758780 (0.0000)	0.946908 (0.0000)	1.325477 (0.0000)
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000
No. of observations	1937	1937	1504	1504
<b>Panel B: Core inflation</b>				
	3-month ahead	9-month ahead	6-month ahead	12-month ahead
$\hat{\alpha}$	0.358212 (0.0000)	0.274911 (0.0000)	0.422821 (0.0000)	0.326668 (0.0000)
$\hat{\beta}$	-0.062959 (0.4079)	0.392143 (0.0000)	-0.673636 (0.0000)	-0.197418 (0.0376)
Prob(F-statistic)	0.407949	0.0000	0.0000	0.0000
No. of observations	1937	1937	1504	1504

Notes: p-values in parenthesis

## 5. DETERMINANTS OF THE INFLATION EXPECTATIONS

To shed further light on the expectation formation process, in this section we explore the role of some variables as driving factors behind the inflation expectations declared by the PwC panel. In particular, we assess significant of the following potential determinants: the inflation target of the European Central Bank (ECB) (proxied as 2 per cent), nominal exchange rate (USD/EUR), real growth (proxied by the growth rate of the industrial production index), core inflation rate, changes in the ECB official interest

rate and lagged inflation expectations. Note that information regarding these variables is always available at the time the expectations are formed.

$$\pi_{t+k}^e = \pi_{target,t} + \alpha_1 s_t + \alpha_2 \rho_t + \alpha_3 \pi_{core,t} + \alpha_4 \Delta i + \alpha_5 \pi_{t+k-1}^e + \varepsilon_{t+k} \quad (3)$$

**Table 5: Determinants of the inflation expectations**

	3-month ahead	6-month ahead	9-month ahead	12-month ahead
ECB Inflation Target	-0.141659 (0.0005)	-0.295901 (0.0000)	-0.132021 (0.0023)	-0.222871 (0.0000)
Nominal Exchange Rate	0.243537 (0.0001)	0.516912 (0.0000)	0.270501 (0.0000)	0.442695 (0.0000)
Real Growth	0.004353 (0.0000)	0.007969 (0.0000)	0.004332 (0.0000)	0.005687 (0.0000)
Core Inflation Rate	0.069069 (0.0000)	0.108148 (0.0000)	0.073107 (0.0000)	0.097373 (0.0000)
Changes in ECB Official Interest Rate	-0.131426 (0.0006)	0.056819 (0.0815)	-0.113218 (0.0057)	0.065507 (0.0542)
Lagged Inflation Expectations	0.929534 (0.0000)	0.880365 (0.0000)	0.904352 (0.0000)	0.866727 (0.0000)
R-squared	0.961531	0.960168	0.931463	0.936204
Durbin-Watson stat	2.033311	1.907787	2.126202	1.924588
No. of observations	1936	1503	1936	1503

As can be seen in Table 5, our results indicate quite a significant persistence of inflation expectations, since the estimated autoregressive coefficients are very high (ranking from 0.8667 to 0.9295). In addition, expectations are positively related to the current core inflation and growth rates and the exchange rate. On the other hand, results also suggest a negative coefficient for ECB inflation target, while the coefficient for the ECB official short-term interest rate is negative for  $k=3$  and 9, and positive for  $k=9$  and 12. Therefore, the PwC panel appears to incorporate the information content of a broad set of macroeconomic variables when forming their inflation expectations.

## **6. CONCLUDING REMARKS**

Expectations are essential for determining economic outcomes and for policymakers. Survey-based measures of inflation provide point forecasts of inflation expectations at various horizons, covering both the short and medium to longer term.

In this paper, we aim to provide a simple investigation of Spanish survey-based inflation expectations. To that end, we have investigated predictive ability and consistency properties of inflation expectations using a survey conducted in Spain by PwC among a panel of experts and entrepreneurs, offering further evidence on the explanatory power of expectations directly observed from survey data.

Our results suggest that the PwC panel has some forecasting ability for time horizons from 3 to 9 when tracking future general inflation rate, improving when it comes to predict the core inflation rate. Nevertheless, the results confirm that predictions made by survey participants neither unbiased nor efficient predictors of future inflation rates, regardless of the measures of inflation used.

As for the consistency properties of the inflation expectations formation process, we find that panel members form stabilising expectations in the case of the headline inflation rate, both in the short and in the long-run, although in the case of the core inflation rate, consistency remains indeterminate.

When considering a set of information variables that are relevant for predicting inflation and are available at the time the expectations are formed, we find that inflation expectations are very persistent and that they are positively related to the current core inflation and the USD/EUR exchange rate, but negatively related to ECB inflation target, while the sign of the coefficient for the ECB official short-term interest rate depends on the forecast horizon.

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