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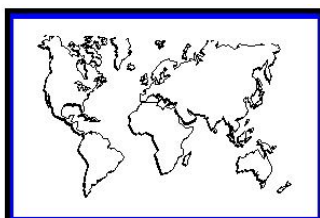
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**On the forecast accuracy and consistency of exchange rate expectations:  
The Spanish PwC Survey**

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**Abstract:**

We examine the predictive ability and consistency properties of exchange rate expectations for the dollar/euro using a survey conducted in Spain by PwC among a panel of experts and entrepreneurs. Our results suggest that the PwC panel have some forecasting ability for time horizons from 3 to 9 months, although only for the 3-month ahead expectations we obtain marginal evidence of unbiasedness and efficiency in the forecasts. As for the consistency properties of the exchange rate expectations formation process, we find that survey participants form stabilising expectations in the short-run and destabilising expectations in the long-run and that the expectation formation process is closer to fundamentalists than chartists.

Keywords: Exchange rates, Forecasting; Expectations; Panel data; Econometric models.

JEL classification: F31, D84, C33

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## **I. Introduction**

Foreign exchange markets are one of the largest financial markets in the world, both for its daily trading volume as its impact on the behaviour of other markets, whether financial assets or goods and services. In this regard, it is worth noting that, according to the latest triennial survey of the Bank of International Settlements on trading volumes in foreign exchange markets and foreign exchange derivatives (BIS, 2010), the world's daily operations, currency exchange markets stood at April 2010 at around U.S. \$ 4 billion.

Given that are highly developed and have large turnover, it is usually assumed that price formation in foreign exchange markets fully reflects all available information and therefore market participants' expectations should be rational and consistent.

The basic problem of the expectations approach to forecasting is how to uncover market participants' expectations. 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.

We examine the predictive ability and consistency of expectations about the dollar/euro exchange rate based on the quarterly survey conducted by the Spanish branch of PricewaterhouseCoopers (PwC). Our sample consists of thirty four surveys covering the period from the fourth quarter of 2001 to the second quarter of 2011.

The paper is organised as follows. Section II describes the data. In Section III the forecast accuracy of the survey is assessed. Section IV examines the consistency properties of the exchange rate expectation formation process of short and long forecasts. Finally, in Section V some concluding remarks are offered.

## **II. 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 exchange rate expectations for the euro-dollar case. 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 this exchange rate. The dates when the surveys were conducted have been recorded. We have included in the data set the spot, 3-, 6-, 9-, and 12-month ahead exchange rates taking from the European Central Bank's Statistical Data Warehouse.

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 30.94 percent of respondents), financial system (23.75 percent), universities and economic research centres (22.80 percent), business and professional associations and institutions (16.98 percent). The number of participants of the survey varies from 95 in the third quarter of 2009 to 161 in the fourth quarter of 2002, being 123 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 34 of the 39 surveys available<sup>1</sup>. On average, the number of survey participants who responded to our question of interest was 116, reaching its maximum and minimum in the fourth quarter 2002 to third quarter of 2009 with 88 and 161 people, respectively.

### III. Forecast accuracy

We initially evaluated the forecasting performance of the PwC panel 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 (see Pindyck and Rubinfeld, 1998, 210-214).

Table 1 shows the forecasting performance of our panel for 3-, 6-, 9- and 12-month ahead. As can be seen, the RMSE is very low and increases with the forecast horizon until  $k=9$ , decreasing later for  $k=12$ . Regarding the Theil inequality coefficient, it always lies closer to zero, indicating a very tight fit. As for the bias proportion, since it is always zero, it suggests no 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 exchange rate, at least for the horizons  $k=3, 6$  and  $9$ . 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).

[Insert Table 1, here]

To assess if the PwC panel is able predict more accurately than a random walk the direction of exchange-rate movements, we have also computed the percentage of correct predictions. As can be seen in Table 2, the panel forecasts show a value higher than 50%, clearly outperforming the random walk directional forecasts in the horizons  $k=3, 6$  and  $9$ .

[Insert Table 2, here]

Therefore, the evidence presented in Tables 1 and 2 suggests that the PwC panel have some forecasting ability, at least until 9-month ahead.

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 exchange rates. If the forecasts made by panel participants are unbiased and efficient predictors of the

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<sup>1</sup> We do not have detailed information for the question of the exchange rate for the surveys corresponding to the third quarter of 2007, the first and second quarters of 2008, the second quarter of 2010 and finally the third quarter of 2011.

future exchange rate, a regression of the observed spot rate at time  $t+k$  on the expected rate determined at time  $t$  for  $k$ -periods ahead

$$S_{t+k} = \alpha + \beta F_{t+k} + \varepsilon_{t+k} \quad (1)$$

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:  $H_0 : \hat{\alpha} = 0, \hat{\beta} = 1$ .

[Insert Table 3, here]

As can be seen, the results suggest that we can decisively reject the null hypothesis for forecast horizons greater than 3, indicating that such forecasts are not unbiased and efficient predictors of the future exchange rate. Only for the 3-month ahead forecasts we fail to reject the null hypothesis at the 10% significance level, therefore obtaining marginal evidence of unbiasedness and efficiency.

#### 4. Expectation consistency

According to Froot and Ito (1989), consistency of expectations formed at the same point in time prevails if expectations about exchange rate changes during subsequent shorter time periods and expectations about the exchange 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 exchange rates.

Following Frankel and Froot (1987a, b) and Frenkel and Rülke, we assume that exchange 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:

$$E_{t,i}(s_{t+k}) - s_t = \alpha_k + \beta_k (s_{t-1} - s_t) + \xi_{t,i} \quad (2)$$

where  $s_t$  and  $E_{t,i}(s_{t+k})$  denote, respectively, the log of the exchange rate and the log of the expected exchange rate for  $t+k$  of forecaster  $i$  at time  $t$ . Subscript  $k$  denotes the forecast horizon and  $\xi$  the error term. A negative  $\beta_k$  indicates a depreciation of the euro during the period preceding the time of the forecast leads panel members to expect a further depreciation for the next period, expectations being in this case destabilising. In contrast, if  $\beta_k$  is positive, it would indicate that whenever the euro depreciates, panel members would expect an appreciation for the next period, expectations being in this case stabilising.

Applying equation (2) to the 3 and 9 month horizon, we obtain:

$$E_{t,i}(s_{t+3}) - s_t = \alpha_3 + \beta_3 (s_{t-1} - s_t) + \xi_{t,i} \quad (3)$$

and

$$E_{t,i}(s_{t+9}) - s_t = \alpha_9 + \beta_9 (s_{t-1} - s_t) + \zeta_{t,i} \quad (4)$$

Similarly, for the to the 6 and 12 month horizon, we obtain:

$$E_{t,i}(s_{t+6}) - s_t = \alpha_6 + \beta_6(s_{t-1} - s_t) + v_{t,i} \quad (3')$$

and

$$E_{t,i}(s_{t+12}) - s_t = \alpha_{12} + \beta_{12}(s_{t-1} - s_t) + v_{t,i} \quad (4')$$

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) and (3) [or (2') and (3')] for such forecasting horizons.

Table 4 reports the results. As can be seen, the short-run  $\beta$  are positive while the long-run  $\beta$  are negative 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 destabilising expectations in the long-run. This result suggests that we should reject the null hypothesis that short-run forecasts are consistent with long-run forecasts. Our finding is in line with Frenkel and Rülke (2011), who detect that participants in the WSJ semiannual survey of professional forecasters expected a "twist" for the dollar/euro exchange rate during the 2003-2007 period.

[Insert Table 4, here]

## 5. Concluding remarks

Understanding how agents form expectations is at the centre of an ongoing discussion in the literature whether or not the trading behaviour in speculative markets destabilizes market prices. We have investigated predictive ability and consistency properties of exchange rate 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 have some forecasting ability for time horizons from 3 to 9 months, although only for the 3-month ahead forecasts we obtain marginal evidence of unbiasedness and efficiency in the forecasts.

As for the consistency properties of the exchange rate expectations formation process, we find that survey participants form stabilising expectations in the short-run and destabilising expectations in the long-run.

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**Table 1: Forecast accuracy**

	RMSE	Theil inequality coefficient	Bias proportion	Variance proportion	Covariance proportion
3-month ahead	0.0604	0.0239	0.0000	0.0380	0.9620
6-month ahead	0.0825	0.0332	0.0000	0.1550	0.8450
9-month ahead	0.1005	0.0389	0.0000	0.1498	0.8502
12-month ahead	0.0941	0,0714	0.0000	0.4504	0.5496

**Table 2: Directional forecast evaluation**

3-month ahead	55.56
6-month ahead	62.50
9-month ahead	55.56
12-month ahead	50.00

**Table 3: Forecast optimality evaluation**

	3-month ahead	6-month ahead	9-month ahead	12-month ahead
$\hat{\alpha}$	0.0688 (0.5779)	0.5646 (0.0049)	0.3204 (0.1658)	1.0268 (0.0000)
$\hat{\beta}$	0.9739 (0.0000)	0.5424 (0.0013)	0.8005 (0.0005)	0.1906 (0.1478)
Prob(F-statistic)	0.0000	0.0013	0.0004	0.1478
Wald F-test	3.0471 (0.0756)	5.7571 (0.0150)	5.7154 (0.0134)	21.3140 (0.0001)
No. of observations	2075	1883	2075	1883

Notes: p-values in parenthesis



**Table 4: Expectation formation processes**

	3-month ahead	9-month ahead	6-month ahead	12-month ahead
$\hat{\alpha}$	-0.0043 (0.2576)	-0.0133 (0.0049)	-0.0009 (0.9213)	0.0152 (0.7424)
$\hat{\beta}$	0.2806 (0.0900)	-0.0420 (0.8994)	0.1325 (0.7245)	-1.5487 (0.4117)
Prob(F-statistic)	0.0900	0.8994	0.7243	0.4117
No. of observations	2075	2075	1883	1883
Wald-test $\alpha_k = 0, \beta_k = 0$	2.1571 (0.1481)	1.5230 (0.2467)	0.0942 (0.9107)	0.5870 (0.5671)

Notes: p-values in parenthesis