Do Households Anchor their Inflation Expectations?
Evidence from a Quantitative Survey on Italian Consumers

Joshy Easaw[a] , Roberto Golinelli[b] and Marco Malgarini[c]

Abstract.

The purpose of the present paper is to investigate the anchoring behavior of households as they form their expectations about the inflation. We consider a number alternative anchors: the inflation targets set by the monetary authorities, the professional forecasts, the current inflation rate, and the households' own perception of current inflation rate. As the acquisition of relevant information is costly for households, we use the recent framework of 'sticky information expectations' to model the households' anchoring behavior when forming their expectations. The empirical analysis is undertaken using novel monthly survey-base dataset of households' opinions of inflation compiled using Italian households.

This version: November 1, 2010 @ 8:04:53 PM

Eliminato: 7:47:30 PM

([a]) School of Business and Economics, University of Swansea, Singleton Park, Swansea, SA2 8PP, United Kingdom; J.Easaw@swansea.ac.uk

([b]) Department of Economics, University of Bologna, Strada Maggiore 45, 40125 Bologna, Italy; roberto.golinelli@unibo.it

([c]) Business and Consumers Survey Unit, ISAE, Piazza dell'Indipendenza 4, 00185 Rome, Italy; m.malgarini@isae.it

for the most updated version link to:
http://www2.dse.unibo.it/golinelli/research/EGMciretNY.pdf

Index

Keywords: Inflation expectations, perceived inflation, survey data, heterogeneous panels, nonlinear effects.

JEL classification: D1, D84, E1, E31, C33

1. Introduction [1]

Most models explaining aggregate outcomes, such as business cycles and inflation dynamics, include the households' expectations. Nevertheless, how households form their expectations about the macroeconomy is less well studied or understood. A number of recent influential papers have introduced the notion of 'rational inattentive' behavior to explain how households (or non-experts) form expectations of the macroeconomy. Specifically, Reis (2006a and 2006b) argue that both consumers and producers update their information set sporadically. Producers do not continuously update their production plans but choose a price for their output and an optimal time at which to be inattentive, that is they receive no news about the economy until it is time to plan again. Similarly, time constrained consumers optimize their utility and undertake consumption decisions infrequently. The slow diffusion of information among the population is due to the costs of acquiring information as well as the costs of reoptimization. Such 'sticky information' expectations has been used to explain not only inflation dynamics (Mankiw and Reis, 2002) but also aggregate outcomes in general (Mankiw and Reis, 2007) and the implications for monetary policy (Ball et al, 2005).

Recently Carroll (2003 and 2006) put forward a specific form of 'sticky information' expectations that best explains how households form their expectations about the macroeconomy. 'Epidemiological expectations' argues that households form their expectations by observing the professionals' forecasts which are reported in the news media. They, however, observe the professionals' forecasts imperfectly by 'absorbing' over time and, eventually, transmitting forecasts throughout the entire population This proposition is verified empirically using the US household based survey (Michigan SRC) and the Survey of Professional Forecasters (SPF). In a related research Mankiw et al (2004) considered how disagreements may arise amongst different agents' inflation expectations. They conclude that any disagreement and heterogeneity found amongst various professionals' and households' inflation forecasts are largely due to the varying rates at which these agents update their relevant information set.

[1] Paper to be presented at the 30th CIRET Conference, The Conference Board, New York, NY, October 13-16, 2010, and at the Federal Reserve Bank of New York conference on "Consumer Inflation Expectations", New York, NY, November 18-19, 2010. Many thanks are due to John Lewis and to conferences' participants for helpful comments and suggestions. The usual disclaimer applies. PRIN financing is gratefully acknowledged (R. Golinelli).

A number of recent empirical investigations have also considered both the issue of heterogeneity and imperfect information when households form their expectations (see, for example, Branch, 2007). Lanne et al (2009) considered an interesting extension of Carroll's epidemiological model. They showed empirically that a hybrid version of the sticky information model explains how households form their expectations; partly forming their expectations naïvely on recently released inflation rates and partly on professionals' forecasts. Bryan and Venkatu (2001a and b) focused on demographic differences specifically gender differences, when households form their views of inflation rates; both inflation expectations and perceptions.

A closely related recent research attempts to analyze whether households' inflation expectations are 'anchored' on the inflation targets set by central banks (see for example, Levin et al, 2004, Kelly, 2008, Blanchflower and Mac Coille, 2009, and references therein). While definitions may vary, here we refer to Bernanke (2007) who provides an intuitive definition for anchored inflation expectations: if the public experiences a spell of inflation higher than their long-run expectation, but their long-run expectations of inflation changes little as result, inflation expectations can be considered to be anchored. This definition can be applied to the public anchoring their expectations, in the long-run, to inflation target.

The present paper will explore and bring together the main issues highlighted in these related research. The simple question we ask is: To whom do households anchor when forming their inflation expectations? Do they, in the long-run, anchor on the professional's forecasts or on the central bank's targets? Are these anchors mutually exclusive?

The underlying premise is also the one that motivates the rational inattentive behavior, that is the cost of acquiring relevant information. The least costly option for the household would be to anchor their expectations on the central bank's target. However, this could also be the most costly option if these targets are not credible. While observing the professional's forecasts and acquiring the most recent actual inflation figures are costly, it may be worthwhile if the inflation targets set by monetary authorities lack credibility. Furthermore, the general public anchors on the professional's due to ignorance of the inflation target cannot be credible as it would be more costly to observe the former. The fact that professional's may anchor on a inflation target is coincidental – and the public would be unaware of this. Finally, it would be illogical for the public to acquire the inflation target via the professional's forecasts because too costly. Nevertheless, we do not discount the fact that the public (or proportion of the public) may look to anchor on both. During periods of macroeconomic uncertainty, they may choose to 'hedge their bets'.

The paper investigates these issues using a novel survey-base dataset of households' opinions of inflation, which is compiled on a monthly basis from February 2003 for Italy and within the framework of the harmonized project of the European Commission. The initial empirical analysis follows the aggregate approach of the 'sticky information expectations' literature. Subsequently, we investigate empirically using a pseudo-panel approach.

The empirical results clearly indicate that households anchor their expectations on the professional's forecasts in the long run. We find that households are excessively sensitive to current inflation (or perceptions of current inflation) when forming their expectations. The estimated long-run inflation expectations of all households are also considerably higher than the ECB targets for the period, despite their long-run anchoring on professional's forecasts, which approximates the inflation targets. Households' inflation expectations tend to be lower with education (the university-educated having the lowest). Similarly, the absorption rates increase with education. There are also clear differences in behavior between male and females for all categories of households considered.

Our analysis further considers the role of current inflation signals when households form their expectations. We find that current signals are used to determine the future direction of inflation rates, and that households respond to them in an asymmetric, or a non-linear, manner. In fact, the absorption rates of all households increase considerably when they expect future inflation rates to rise.

The structure of the paper is as follows. The next section 2 outlines the issues that will be considered in the light of their models' specification, and leads to a model which extends the Carroll's epidemiological version of the 'sticky information expectations' model. Section 3 describes the dataset and reports some preliminary empirical results conducted either along the individual dimension in repeated cross-sections, or over time at macro-aggregate level (i.e. county-wide). Section 4 extends the analysis to panes where survey's households are grouped in pseudo-individuals whose categories are defined on the basis of households' individual characteristics. In addition, we also allow for both heterogeneity and nonlinearities in groups' behavior. Finally, Section 5 outlines the summary of the key results and draws the concluding points.

2. Household inflation expectations and anchoring behavior: the model

If households anchor their inflation expectations on targets set by monetary authorities these expectations should not be excessively sensitive to actual inflation or their own perceptions of current inflation. Hence, households update their expectations ($E_t^h(\pi_{t+1})$) independently of changes to current (or the most recently published) inflation rate (π) and/or to their inflation perceptions ($\pi^{P,h}$)[2]. Therefore, excess sensitivity of inflation expectation can be simply tested as follows:

$$\Delta E_t^h(\pi_{t+1}) = \alpha + \beta'\Delta\pi_t + \beta''\Delta\pi_t^{P,h} + \varepsilon_t \qquad (1)$$

where ε_t is an *iid* error term. Excess sensitivity is not found if $\hat{\beta}' = \hat{\beta}'' = 0$; in this context, households' expectations are not anchored on inflation targeting (this could loosely be seen as a test to the monetary authority's credibility).[3]

A possible drawback of equation (1) is that it only focuses on first differences and disregards level relationships and potentially long-run anchoring. For this, the analysis can be broaden to include Carroll's (2003, 2006) epidemiological model and, thereby, directly test possible competing hypotheses. The household observes imperfectly the professionals' forecasts, which is assumed to be rational. Hence households have partial access to rational information (see Mankiw and Reis, 2002) and 'absorbed' over time and the epidemiological model where households anchor on the professional's forecasts can be depicted as follows:

$$E_t^h(\pi_{t+1}) = \lambda E_t^F(\pi_{t+1}) + (1-\lambda)E_{t-1}^h(\pi_t) + \varepsilon_t \qquad (2)$$

where $E_t^F(\pi_{t+1})$ are the professional's forecasts, which individuals can learn from the media news. Equation (2), which assumes the dynamics of a simple partial adjustment mechanism and can be generalized in the error-correction (EC) specification, where short- and long-run dynamics are not restricted to share the same speed of adjustment

[2] While previous studies have only considered actual inflation, the households' perception of current inflation should also be used, if available. It may be the case that during periods of uncertainty the public may be unable to distinguish between general and individual specific price shocks they experience.
[3] Excess of sensitivity can be assessed by comparing estimation results either across counties, as in Levin et al (2004), or over time, as in Kelly (2008) and in Blanchflower and Mac Coille (2009).

(measured by $-\lambda$), but allow for two different parameters, λ_1 and λ_2, which respectively drive the short- and the long-run dynamics:[4]

$$\Delta E_t^h(\pi_{t+1}) = \lambda_1 \Delta E_t^F(\pi_{t+1}) + \lambda_2 [E_{t-1}^h(\pi_t) - E_{t-1}^F(\pi_t)] + \varepsilon_t \tag{3}$$

The adjustment towards long-run levels requires that $\lambda_2 < 0$; under the restriction $\lambda_1 + \lambda_2 = 0$ model (2) is nested in model (3). The rejection of the latter restrictions suggests the data congruency of an EC dynamics which allows for possible short term overshooting, or overreaction, by households as they learn about professionals' forecasts. In fact, in the EC context of model (3), λ_1 is the impact absorption rate, which if unrestricted can be larger than one, and $-(\lambda_1+\lambda_2)$ is the one-month-later absorption rate, as households adjusts their expectations to the professionals' forecasts if $(\lambda_1+\lambda_2) > 0$.[5]

If households' expectations are also sensitive to own inflation perceptions, to the most recently available figure of the actual inflation rate[6], and to the inflation target π^{T} (assumed to be time invariant), Carroll's model (2) can be extended to:[7]

$$\begin{aligned} E_t^h(\pi_{t+1}) &= \lambda(\phi_1 E_t^F(\pi_{t+1}) + \phi_2 \pi_t^{P,h} + \phi_3 \pi_{t-1} + \phi_4 \pi^{\mathrm{T}}) \\ &+ (1-\lambda) E_{t-1}^h(\pi_t) + \varepsilon_t \end{aligned} \tag{3'}$$

where expectations average the four measures above, with parameters ϕ_i measuring the weights in setting households' expectations of: professional's forecast (i=1), households' perceived inflation (i=2), actual inflation rate (i=3), and the inflation target (i=4). In this way, individuals are assumed to form their expectations by switching between the variables above as dictated by the prevailing economic conditions and situation.

Equation (3') dynamics may be generalized (as above) to obtain the basic model for empirical investigation encompassing the different approaches of the anchoring literature (i.e. excess sensitivity) and Carroll's epidemic dynamics:[8]

---

[4] A change in professional forecasts is defined as: $\Delta E_t^F(\pi_{t+1}) = E_t^F(\pi_{t+1}) - E_{t-1}^F(\pi_t)$; similarly for the update of households' inflation expectations, $\Delta E_t^h(\pi_{t+1})$.

[5] The regressors of impact and one-month-later absorption parameters are $E_t^F(\pi_{t+1})$ and $E_{t-1}^F(\pi_t)$.

[6] Actual inflation is one-month lagged in order to account for the publication delay of the official figures.

[7] In a recent paper, Lanne et al (2009) introduces an extended or hybrid model of Carroll (2003) which similarly includes current inflation signals.

[8] Here, for simplicity, we assume that households' expected inflation is generated by a first-order process. In empirical applications, if the test for residuals' autocorrelation of model (4) rejects the null, we can augment equation (4) with lags of the short run regressors in differences to induce white noise residuals.

$$\Delta E_t^h(\pi_{t+1}) = \lambda_{11}\Delta E_t^F(\pi_{t+1}) + \lambda_{12}\Delta\pi_t^{P,h} + \lambda_{13}\Delta\pi_{t-1} + \lambda_2[E_{t-1}^h(\pi_t) - \phi_1 E_{t-1}^F(\pi_t) - \phi_2\pi_{t-1}^{P,h} - \phi_3\pi_{t-2} - \phi_4\pi^T] + \varepsilon_t \tag{4}$$

where λ_{1i} (i = 1, 2, 3) are three parameters measuring short run fluctuations of the households' expectations due to changes in professional forecasts (i=1), in households' perceived inflation (i=2), and in one-month lagged actual inflation (i=3); λ_2 is the speed of adjustment towards the long run; ϕ_i parameters are defined as in equation (3'). Returning to the issue of two-speed absorption rates (i.e. the impact (λ_{11}) and the one-month-later ($-[\lambda_{11} + \lambda_2\phi_1]$)), model (4) implies that households' overreacts relative to the professional forecasts if $\lambda_{11} > 1$, $\lambda_{11} \approx \phi_1$, and $-1 < \lambda_2 < 0$.

Following the definition proposed in Bernanke (2007), inflation targeting in model (4) is anchored to households' expectations in the long run. However, assuming that the target is time invariant over the sample period, the constant of equation (4) corresponds to parameters' combination $-\lambda_2\phi_4\pi^T$ which does not allow to identify two separate values for ϕ_4 and π^T. It is not possible to verify whether π^T is consistent with the inflation target, which the present case will the be 2%, the actual of the European Central Bank. Nevertheless, even if households anchor on this target, it is credible if the estimated $\phi_4\pi^T = 2\%$ or, alternatively, if $\hat{\phi}_4 = 1$.

There are a number of possible restrictions to the general model (4) to verify the nested models of the anchoring literature (i.e. excess sensitivity) and the epidemiological dynamics. In particular, the inferences using model (1) – as excess sensitivity literature does – are appropriate only if $\lambda_2 = 0$, as only in this case the levels of the explanatory variables can be excluded from the reference model of the test. The Carroll's "pure" epidemic dynamics in model (2) – with or without inflation anchoring (depending on ϕ_4 being different or equal to zero) – is a data congruent representation of the process generating the households' expectations only if the following restrictions are valid: $\lambda_{12} = \lambda_{13} = 0$, $\phi_2 = \phi_3 = 0$ (which exclude the role of actual and perceived inflation in both the short- and long-run), and $\lambda_{11} + \lambda_2 = 0$, $\phi_1 = 1$ (which collapse the dynamics in a simple partial adjustment).

3. Measurement of the variables and a preliminary inspection to data

The individual inflation expectations over the next 12 months and the individual inflation perceptions over the past 12 months are respectively labeled as $E_t^h(\pi_{t+1})$ and as $\pi_t^{P,h}$. The 83 ISAE surveys – collected each month for 2,000 households from February 2003 to December 2009 – are the available source of the two variables; for further information see Malgarini, (2009)[9].

The *h* index in the labels above can alternatively represent (and measure):

1. the N monthly survey's individual answers – in this case *h* = 1, 2, ... , N (with N = 2000 households). Note that the whole information set is not a panel, as the same people are not interviewed repeatedly, but simple repeat cross-sections of N×T observations, where we pool together all the available monthly surveys (cross-sections).
2. the monthly average of the N individual survey's answers – in this case the information set is a single time series of T = 83 monthly observations, *h* = M (which stands for "mean");
3. intermediately, we can average the N monthly answers in G groups (i.e. pseudo-individuals) defined on the basis of individual characteristics also reported by the survey (such as gender, age, education, and employment) – in this case *h* = 1, 2, ... , G (with G being much smaller than N). The resulting information set is a pseudo panel of G×T observations; with ISAE survey data see e.g. Malgarini et al (2009).

For Italy, the professional's forecast time series $E_t^F(\pi_{t+1})$ lacks of an obvious way to measure it, such as the Survey of Professional Forecasters for the US. For this reason, we had to compute a consensus forecast, defined as the average of the Italy's inflation forecasts made by different national and international institutes whose predictions are usually emphasized by media as soon as they are issued; details are in Appendix A1.

[9] The ISAE survey provides point forecasts about inflation expected for 12 months ahead; no information is available on individual' uncertainty about future inflation. For the importance of that kind of information in evaluating Central Bank credibility, see for instance De Bruin et al (2009).

The actual inflation rate π_t can be based on Itay's consumer price index (CPI, source ISTAT). In particular, monthly inflation may be alternatively measured by the CPI growth rate over the past 12 months: $\pi_t = 100 \times \frac{CPI_t - CPI_{t-12}}{CPI_{t-12}}$, or by the CPI annualized monthly growth rate: $\pi_t = 1200 \times \frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$; see e.g. Lanne et al (2009). In the following parts we will report results with the annualized monthly growth rate data, though the outcomes are robust to the measure adopted.

Overall, the three alternative levels of aggregation of ISAE surveys' individual data described above lead to very different information sets: (1) repeated cross-sections, (2) aggregate time series, and (3) pseudo panels. In the following two sections, we will preliminarily analyze the main features of type (1) and (2) data, respectively.

3.1. Analyzing the repeated cross sections data-set

Though the first information set (repeated cross-sections) does not allow the estimation of models such as equation (4) where individual inflation expectations and perceptions are lagged or in differences, it has the advantage of exploiting the wealth of many variables observed about 120,000 times.

Therefore, with this data-set we can first assess whether the individual characteristics tend to be correlated with the respondents' inflation expectations. Columns (1)-(2) of Table 1 describe the sample composition of selected characteristics usually found in the literature to influence the formation of inflation expectations: employment, education, gender and age. Then, columns (3)-(4) report means and standard deviations of inflation forecasts by group.

Table 1 here

At a first look, the large disparity in the forecasts made by different groups of individuals clearly emerges, together with some regularities. For example, similarly to the findings of Malgarini (2009), expected inflation decreases with age and education (old people with a degree predict smaller price increases than those of younger and less educated people), and women expect higher rates of inflation than men. Similar results are often found in literature (see e.g. Bryan and Venkatu (2001a) for the US, and Blanchflower and Mac Coille (2009) for the UK), though some works find quite different outcomes, see e.g. Lombardelli and Saleheen (2003) for the UK.

Of course, being based on unconditional means, results in column (3) are each other related because individual characteristics are often each other related too. For example, age, employment and income[10] move together since it is quite obvious that older people probably are no longer employed (pensioners), and – consequently – both groups tends to predict lower-than-average inflation rates.

In order to disentangle the (marginal) effect of a change in one characteristic keeping fixed all the other, in columns (5) and (6) of Table 1 we report the OLS estimates of models with dummy variables for individual characteristics, and with/without time effects, respectively. On the basis of such estimates, we can formally assess for the statistical significance of the deviations of the inflation corresponding to each characteristic to that of the reference group (reported in the last row of Table 1).

We define the reference group as the categories that in column (2) have the highest frequency within each of the four characteristics, i.e. male aged 30-49 with upper secondary education who is a white collar employee. Apart of pensioners and people with less than 30 years, all other deviations from the reference group forecasts are at least 5% (very often 1%) significantly different from zero. Being self-employed or aged more than 64 years induces the largest absolute deviations from the reference group: respondents belonging to these two categories hold a more than 1 percent lower inflation expectations than that of the reference group (1.5 per year for oldest people). Vice versa, low educated people expect about 1 percentage point more inflation than the reference group. Though in a less pronounced way than in Bryan and Venkatu (2001b), we confirm the existence of significantly different inflation forecasts of men and women. In general, estimation results in Table 1 are robust to the inclusion of time effects, see columns (5) and (6). The inclusion of a common time pattern for all the survey respondents in column (6) does not worsen individual characteristics' ability to explain inflation expectations, but only induces a better explanatory ability of the model augmented with time dummies.[11]

Finally, we can further extend the time effects model by adding the perception of inflation over the twelve months preceding each survey date and the consensus

[10] Income was not used here because many observations would have been lost because of non responses. In addition, Malgarini (2009) finds that income, together with the size of municipality, does not affect inflation expectations.

[11] Time effects are simple month dummies. Given the sample span of our monthly data, the model in column (6) has 83 time dummies, i.e. 83 parameters more than those in the model of column (5). By definition, the estimates of these 83 time effects measure the average pattern of the inflation expectations of survey respondents.

forecasts. Given that the model with time effects also includes dummy variables for the individual characteristics, we not only added the two regressors (i.e. the perceived inflation and the consensus forecast), but also their interactions with all individual characteristics. Overall, 24 explanatory variables are added.

Along the three columns of data in Table 2, the main estimation outcomes are reported with reference to the model with only individual characteristics (in the first column), to the model with individual characteristics and time effects (in the second column), and to the latter model extended to the perceived inflation, to the consensus inflation forecasts, and to their interactions with individual characteristics (in the third column).

Table 2 here

Results in terms of p-values of joint zero restrictions to the parameters of each category can be summarized as follows. In the last column of Table 2 it is evident that the introduction of interactions between perceived inflation, consensus forecast and individual characteristics leads to not significant shift parameters measuring the deviations from the reference group, while such shifts are largely significant in the two models without interactions. This evidence of significant shifts is reported in the first two columns of Table 2, and mirrors the outcomes discussed above in the last two columns of Table 1.

The significance detected above justifies the improvements in models' explanatory ability when additional variables are added. The model with only individual characteristics is able to explain only a very small portion of the overall variability in the individual inflation forecasts (in the first column of Table 2 the R^2 is equal to 0.004) because it misses regressors able explain the evolution of expected inflation over time. Such time pattern can be captured, albeit in a rough deterministic way, by the inclusion of 83 time effects in the model of the second column of Table 2; consequently model's explanatory ability raises to 0.187. Finally, in the third column of Table 2, model's explanatory ability further raises to 0.298 because of the inclusion of interactions among individual characteristics and the evolution over time of both the perceived inflation and the consensus inflation forecast (see the third column of Table 2).

On the basis of the evidence reported in this section, we preliminary support the view that individual characteristics induce heterogeneous behaviors in different groups of individuals, rather than simple shifts in the average (i.e. common) pattern of the expected inflation. In fact, the expected inflation is better explained by models in which group-specific parameters allow individuals to react with different speeds to the perceived inflation and to the consensus inflation.

3.2. *Aggregate time-series results*

Outcomes in the previous section are based on a very simplified specification of equation (4), as repeated cross sections do not allow for dynamics of the surveyed variables, which on the other hand is a distinctive feature of the referenced literature. An easy way to introduce dynamics is the aggregation of survey data at country level, i.e. by defining the series $E_t^M(\pi_{t+1})$ and $\pi_t^{P,M}$ as the monthly averages of the individual answers. This "macro" approach is the most commonly used in the literature about modeling inflation expectations; see Carroll (2003), Lanne et al (2009), and Mankiw et al (2003), among the others.

With time-series data, equation (4) is a first-order autoregressive distributed lag (ARDL) model, which can be modeled without setting a priori the variables as I(1) or I(0); see Pesaran et al (2001), henceforth PSS. The PSS approach is appropriate here, because the three explanatory variables of our ARDL model may be considered long run forcing (as there is not feedback from the level of the dependent variable). In this context, the PSS 5% critical values of λ_2 t-statistic to test for the existence of a level relationship are -2.86 and -3.78 for I(0) and I(1) regressors, respectively.

Estimation results of equation (4) as well as the outcomes of the general-to-specific modeling approach are reported along the columns of Table 3. Not reported residuals' misspecification test results suggest that one lag is enough to obtain well behaved (i.e. *i.i.d*) residuals. [12]

Table 3 here

Overall, the model explains more than 35% of the inflation expectations variability in Italy over the period 2003m3-2009m12.

We are able to identify four main points. First, a long-run relationship in levels exists between households' inflation expectations and consensus forecasts irrespective of the integration order of the regressors, as shown by all the t-statistics of λ_2 estimates in Table 1 that range from -4.18 to -4.02. This outcome questions the appropriateness of

[12] All unreported and only mentioned results in this paper are available upon request from the authors, together with the corresponding procedures to implement them.

making inferences about inflation anchoring on the basis of models in differences. Instead, Carroll's epidemic model is only partially survey data congruent because, though it assumes the existence of level-relationships, its partial adjustment dynamics implies restrictions on error-correction parameters which are always rejected by data. The estimates of the speed of adjustment λ_2 (around -0.3) suggest that about 30% of the gap between actual and target levels of inflation expectations is closed in the first month. This speed of adjustment is in line with the findings of the empirical literature for the US.

Second, among the regressors assumed by equation (4), the actual inflation rate never plays a significant role. The comparison between the results in columns (2) and (3) suggests that the exclusion from model (4) of the latest-known figure of the annualized month-on-month inflation rate does not entail significant changes in the estimates of the other parameters. This finding is true independently of the specific measure adopted for the actual inflation: annualized month-on-month, or year-on-year (not reported).

Third, not all the three regressors of model (4) – consensus forecasts, perceived and actual inflation rates – play a significant role in shaping households' expected inflation in the long run, see the ϕ_i (with i = 1, 2, and 3) estimates in columns (1) and (2) of Table 3. The effect of consensus on individuals forecasts is considerably large and significant, suggesting a strong reactivity of long-run households' expectations to it, while the other two drivers do not play any appreciable role in the long run. After the exclusion restrictions entailed by previous discussion, the mean individual *M*'s (i.e. aggregate) model (4) collapses to:

$$\begin{aligned}&\Delta E_t^M(\pi_{t+1}) = \lambda_{11}\Delta E_t^F(\pi_{t+1}) + \lambda_{12}\Delta\pi_t^{P,M} \\ &+ \lambda_2[E_{t-1}^M(\pi_t) - \phi_1 E_{t-1}^F(\pi_t) - \phi_4\pi^T] + \varepsilon_t\end{aligned} \tag{5}$$

In equation (5), the short-run changes in households' expectations are still driven by both changes in professionals' forecasts and in current inflation perceptions; the corresponding estimates are in column (3) of Table 3.

Fourth, the long-run interval estimation of the explicit (constant) target effect $\phi_4\pi^{\mathrm{T}}$ is very wide, ranging from negative to positive values, then not significantly different to zero. However, this fact cannot exclude that long-run anchoring on the target passes through professional forecasters behavior. Under the assumption that the constant term is zero, estimates are reported in column (4) of Table 3.

In order to deepen the measure of the long run households expected inflation, we assume that consensus inflation forecasts are represented by a first order auto-regressive model:

$$E_t^F(\pi_{t+1}) = \beta_0 + \beta_1 E_{t-1}^F(\pi_t) + \nu_t \qquad (6)$$

If the AR(1) representation is stationary, consensus forecast collapses on the long run steady state: $E^F(\pi^*) = \beta_0/(1-\beta_1)$. With our data, the 95% confidence interval of the steady-state solution of the consensus $E^F(\pi^*)$ ranges between 1.8 and 2.2, which includes the 2% ECB target.[13]

In turn, the identification of the consensus steady state solution entails that in the long run average households' forecasts are tied to:

$$E^M(\pi^*) = \phi_1 E^F(\pi^*) + \phi_4 \pi^T \qquad (7)$$

Given an estimate of the consensus long run solution $E^F(\pi^*)$ included between 1.8 and 2.2, we can estimate a range for $E^M(\pi^*)$ by using the definition (7), and assess whether the long run households' expected inflation is significantly different to the ECB target.

The lower part of Table 3 reports estimates of the long run solution (7) corresponding to the estimates of model (5) parameters in columns (3) and (4). In particular, we define the point estimate of (7) when $E^F(\pi^*)$ = 2.0, and the higher/lower bounds of it in which $E^F(\pi^*)$=2.2 and $E^F(\pi^*)$=1.8, respectively.

Results point to a 5.1/6.4 range to which household inflation forecasts seem to converge in the long run. Such figures are well above the ECB target, suggesting that in the long run Italian households do not share the official 2% target, but rather they implicitly refer to a considerably higher rate. This fact mirrors the usually high inflation figures that surveyed households report for both inflation perceptions and expectations.

[13] The assumption of a simple AR(1) model is made only for simplicity, as the extension to higher-order dynamics is straightforward. In our case, an AR(4) model with $\beta_2 = \beta_3 = 0$ is a congruent representation of the Italian consensus forecasts. The AR(4) model stationarity is further supported by a number of not reported unit-root tests.

4. Modeling inflation expectations with pseudo-panel data

The exploratory analysis in the previous section highlights two major findings regarding Italian households' formation of inflation expectations: firstly, groups of individuals, selected on the basis of pre-defined personal characteristics (such as education, gender and age), seem to approach inflation forecasts in different ways, leading to quite different levels of expected inflation, that have the common feature of being considerably higher than the actual inflation figures.

Secondly, at economy-wide level (i.e. by using single time series of monthly averages of all the survey respondent), the dynamics of households' inflation expectations follow in the short run changes in both consensus forecasts and perceived inflation over the recent past, while in the long run they are solely driven by the level of consensus of the professional forecasters. The long run solution of the aggregate model suggests that households' inflation expectations fall in a range well above the 2% ECB long run inflation target, despite consensus forecasts closely point to the 2% long run level.

However, two drawbacks affect the methodologies that we followed to obtain these results: (1) at repeated cross-section level, the lack of time dimension of individual data prevented us from estimating appropriate dynamic relationships which, instead, are an essential ingredient of both sticky-information and epidemic inflation expectation theoretical models; (2) at aggregate time-series level, modeling results may be biased because of parameters' heterogeneity across groups.

In this section we will check the extent to which previous drawbacks may have corrupted our main findings. To do this, we will base our analysis on pseudo panels obtained by averaging individual data in groups whose categories are selected on the basis of the individual characteristics outlined in Tables 1 and 2.

In defining the aggregation categories, we have to acknowledge that the number of surveyed individuals belonging to each pseudo panel's group must be large enough to preserve the statistical properties of the pseudo-panel estimators; see e.g. Veerbek and Nijman (1992). In addition, the unavoidable arbitrariness of any category definition suggests to test for the robustness of main findings to alternative ways of grouping individual observations. In this work, we define four alternative pseudo-panels with 7-10 groups each; details about groups' definitions are in Table 4.

Table 4 here

4.1. Pooled mean group estimator for heterogeneous linear models

Given that the time span of our data is quite wide and homogeneous (T = 83 months, covering the post monetary changeover period), we estimated model (4) parameters under the assumption of full heterogeneity, i.e. a complete set of estimates is obtained for each panel's group. Model (4) heterogeneous specification is:

$$\begin{aligned}\Delta E_t^h(\pi_{t+1}) &= \lambda_{11}^h \Delta E_t^F(\pi_{t+1}) + \lambda_{12}^h \Delta \pi_t^{P,h} + \lambda_{13}^h \Delta \pi_{t-1} \\ &+ \lambda_2^h [E_{t-1}^h(\pi_t) - \phi_1^h E_{t-1}^F(\pi_t) - \phi_2^h \pi_{t-1}^{P,h} - \phi_3^h \pi_{t-2} - \phi_4^h \pi^T] + \varepsilon_t^h\end{aligned} \tag{8}$$

where $h = 1, 2, 3, ..., G$ (with $G = 7$ for the first panel definition, 8 for the second, 10 for the third, and 8 for the fourth; see Table 4).

The estimation of the panel heterogeneous models by group (i.e. by each h), and the following analyses were conducted by broadly using the same methodology as that with aggregate time series. Results obtained with panel data # 1 to # 4 are reported in Tables 5-8, respectively.

Table 5 here

Starting from the heterogeneous estimates of model (8) parameters with panel # 1, the existence of a level relationship among the variables of interest, i.e. $\lambda_2^h \neq 0$ is assessed through the outcomes in the first two rows of Table 5, where λ_2^h estimates and the corresponding *t*-statistics are reported. The critical values to be used for testing the null of absence of level relationships by group are again those of PSS (i.e. -2.86/-3.78). Results clearly indicate that the presence of levels is extremely relevant to have a congruent representation of data, as also found with aggregate time series. Given that not all the parameters of model (8) are significant, the following three rows of Table 5 report the p-values of a number tests for the joint significance of the parameters which measure the short- and long-run effects of the actual inflation rate, and the levels of the perceived inflation. Since these parameters are jointly never significant, we restricted them to zero, i.e. $\lambda_{13}^h = \phi_2^h = \phi_3^h = 0$. These restrictions, in a context of individual heterogeneity, lead to a parsimonious and data-congruent model to make appropriate inferences about the long run inflation expectations by group:

$$\begin{aligned}\Delta E_t^h(\pi_{t+1}) &= \lambda_{11}^h \Delta E_t^F(\pi_{t+1}) + \lambda_{12}^h \Delta \pi_t^{P,h} \\ &+ \lambda_2^h [E_{t-1}^h(\pi_t) - \phi_1^h E_{t-1}^F(\pi_t) - \phi_4^h \pi^T] + \varepsilon_t^h\end{aligned} \tag{9}$$

Estimates of the relevant parameters (together with the t-statistics) and the goodness-of-fit measures of each equation are reported in the mid part of Table 5.

For even more efficient inferences, we can use the Pesaran, et al (1999) approach of the pooled mean group estimators (PMG) if the outcome of poolability tests allows for it. Under the PMG assumption, all the long-run coefficients are constrained to be identical across groups, i.e. $\phi_1^h = \phi_1$, while short run coefficients λ_{11}^h, λ_{12}^h, λ_2^h, and variances of errors ε_t^h are still allowed to be heterogeneous; in symbols, our PMG model is written as:

$$\begin{aligned}\Delta E_t^h(\pi_{t+1}) &= \lambda_{10}^h + \lambda_{11}^h \Delta E_t^F(\pi_{t+1}) + \lambda_{12}^h \Delta \pi_t^{P,h} \\ &+ \lambda_2^h [E_{t-1}^h(\pi_t) - \phi_1 E_{t-1}^F(\pi_t)] + \varepsilon_t^h\end{aligned} \tag{10}$$

where: $\lambda_{10}^h = -\lambda_2^h \phi_4^h \pi^T$ represents some sort of time-invariant group effects.

The large non rejection of the restrictions that allow the reduction from model (9) to (10), suggests that maximum-likelihood of PMG is the most efficient estimator to make inferences about the long run expected inflation.

The PMG model always rejects further restrictions on the intercepts (i.e.: $\phi_4^h = \phi_4$ and $\phi_4^h = 0$), which in our context measure the long run targeting effect. Therefore, the last two rows of Table 5 report intervals for the long run solution which differ by group. These intervals of the long run expected inflation is based on the 2% long-run consensus forecast, as we made with aggregate data.

The amplitude of the interval is always the same (about 1.3%). The long-run inflation expectations is lower for the higher educated, with the university-educated having the lowest; the impact of working/not working condition is not clear cut. Nevertheless, it is always considerably higher than that of the professionals' forecast for the period under consideration.[14]

The pseudo individuals' absorption rates (i.e. the negative of the speed of adjustment, $-\lambda_2^h$) vary considerably by working/non working status and education, ranging from 0.79 and 0.32. University-educated households have the highest

[14] The estimation of a constant long run inflation rate expected by the Italian households is statistically sounded if expected inflation is stationary in our pseudo-panels. For this, we also tested for unit roots in our $E_t^h(\pi_{t+1})$ pseudo panels by using the Im et al (2003) heterogeneous panel test. Not reported results further corroborate the assumption of stationary inflation expectations. This outcome is in accordance with the existence of a level relationship between individual expectations and consensus forecasts because we found the latter stationary too.

absorption rates with those not in work absorbing a fifth faster. Conversely, those with elementary and lower secondary education adjust to the consensus forecasts considerably slower. Nevertheless, those with lower secondary education who are in work are twice as fast as those not in work. This group will not only be involved in wage negotiations but have greater opportunities for the social transmission of professional's forecasts through the interact with others, especially in the work place.

The results with pseudo panel # 1 in Table 5 can be validated by running the same steps with alternative groups' definition. Given that groups of panel # 1 were selected on the basis of individuals' education and employment, two alternative panels can be defined by crossing these two characteristics with gender; in particular, panel # 2 is defined on the basis education and gender, and panel # 3 on the basis of employment and gender. Finally, given that also age showed to play some significant role in cross-section regressions, we also defined the panel # 4 on the basis of age and gender.

Results using panels # 2 to # 4 are reported in Tables 6 to 8 which have the same structure as that of Table 5, since the methodological design is the same as that we followed and discussed with panel # 1.

Tables 6-8 here

Overall, we have that, again, the first-order dynamics is enough to represent data in a congruent way, and that the existence of a level-relationship between individual expectations and consensus forecasts is always evident for all groups, irrespectively of the alternative panel definition. Finally, the fully heterogeneous model (9) can always be restricted to the PMG model (10) with p-values above 0.9, and, again, constant terms cannot be restricted neither to zero, nor to the same value across groups within each panel.

Table 6 reports the findings for households with different educational backgrounds and distinguishing between males and females. Once again, the absorption rates are highest for university educated. The remaining households' absorption rates are considerably lower ranging between 0.51 and 0.37. The long-run inflation expectations are lowest for male university educated but their female counterparts have long-run expectations that are 25% higher. The gender difference is evident for all groups, the exception is elementary-educated.

Table 7 and 8 reports the results for households based on occupation and age, also making gender comparisons for the various groups. Absorption rates are highest for the self-employed and female blue collar workers and lowest for pensioners. It is unsurprising that the self-employed has the highest absorption rates. This group (probably more so that any of the others) would have to deal with their own personal finances and engage in price (or wage) setting. Those aged between 50 and 64 years also have higher absorption rates. So do males below 30 years old. The difference between male and females are also pronounced, with the exception of those between the age of 30 and 49 years old.

In the long run, the amplitude of the interval for expected inflation is always more or less the same (about 1-1.5%), while the two extremes change with individuals' characteristics: the lower intervals (about 3.8/5.1) correspond to males either with a degree (see the first column in Table 6) or self employed males (see the first column in Table 7). Female have long run inflation expectations almost ever above to those of males, but the distance between males and females tend to decrease with age and, for oldest people are virtually the same.

4.2. Extensions with nonlinearities

In the analyses so far we have assumed a linearity of the relationship among the variables of interest, presently we will extend the basic linear model to some non-linear relationships. In the preceding empirical investigations, we were unable to establish any significant relationship between current inflation signals and households' expectations in the long-run as found in Carroll (2003) and Lanne et al (2009). We now consider whether such inflation signals are better depicted as a non-linear relationship. Current inflation figures together with the professional's forecasts enables households to determine the future direction, or momentum, of inflation rates and this may have an asymmetric effect on households' expectations.

The future direction – or momentum – of inflation expectations is defined as the difference between consensus forecasts given at time *t* for the next twelve months, minus the latest known inflation release (referring to *t-1*). It could be that, among the others effects, households expectations also account for such change in direction: when the difference is positive, the future inflation rate is expected to go up with respect to "present" values. In addition, it could also be that the perception of such distance depends on how clear for the general public is the forecasters' signal, measured as the monthly standard error of single-institutes' forecasts. In symbols, we can define it:

$$gap_t = \frac{E_t^F(\pi_{t+1}) - \pi_{t-1}}{se_t^F(\pi_{t+1})} \tag{11}$$

which represent the standardized gap between consensus forecast over next year and the most recent known inflation rate, henceforth we will label it as simply "gap".

In the first part of each panel of Table 9, we report the p-values of gap-augmenting the PMG models (10) previously estimated in a linear fashion with both the long- and the short-run (in levels and first differences, respectively). With all the four data sets, gap-additions are never significant. A possible explanation for such not significance is that the "gap effect" enters in a nonlinear way in our relationship, rather than being linear.

Table 9 here

For this reason, we extended the linear PMG model (10) with nonlinear effects driven by the Heaviside indicator function I_t , which is based on the sign of the gap variable defined by equation (11)

$$\begin{aligned}\Delta E_t^h(\pi_{t+1}) &= \lambda_{10}^h + \lambda_{11}^h \Delta E_t^F(\pi_{t+1}) + \lambda_{12}^h \Delta\pi_t^{P,h} + \lambda_{14}^h \Delta gap_t \\ &+ (\lambda_{2P}^h + \lambda_{2N}^h I_{t-1})[E_{t-1}^h(\pi_t) - \phi_1 E_{t-1}^F(\pi_t) - (\phi_5 + \phi_6 I_{t-1}) gap_{t-1})] + \varepsilon_t^h\end{aligned} \tag{12}$$

where $I_t = 1$ if $gap_{t-1} < 0$ and $I_t = 0$ if $gap_{t-1} \geq 0$. In this context, a positive gap (i.e. consensus predicts inflation to go up during the next year) implies that households' long run reactivity to such consensus is $(\phi_1 + \frac{\phi_5}{se_t^F})$, with a speed of adjustment equal to λ_{2P}^h . While a negative gap (when future inflation is expected to go down) implies a long run reactivity equal to $(\phi_1 + \frac{\phi_5 + \phi_6}{se_t^F})$, with a speed of adjustment equal to $(\lambda_{2P}^h + \lambda_{2N}^h)$.[15]

Given that not all the parameters measuring the nonlinear extensions from model (10) to model (12) are significant, after a number of tests (reported in Table 9) we define the following data congruent model that embodies a number of not rejected restrictions :

$$\begin{aligned}\Delta E_t^h(\pi_{t+1}) &= \lambda_{10}^h + \lambda_{11}^h \Delta E_t^F(\pi_{t+1}) + \lambda_{12}^h \Delta\pi_t^{P,h} \\ &+ (\lambda_{2P}^h + \lambda_{2N} I_{t-1})[E_{t-1}^h(\pi_t) - \phi_1 E_{t-1}^F(\pi_t) - \phi_5 (1 - I_{t-1}) gap_{t-1})] + \varepsilon_t^h\end{aligned} \tag{13}$$

[15] In our sample se_t^F is in the 0.07/0.53 range.

Results in Table 9 unambiguously suggest that both λ_{2N} and $\phi_5 > 0$: positive gaps are associated with an higher long run reactivity of households' expectations to consensus (because of $\phi_5 > 0$), which in turn is reached faster (because of $\lambda_{2N} > 0$, the absorption rates of all households increases during periods when consensus inflation rates increase with respect to the present levels). Indeed, female blue collar workers absorb perfectly during these periods. The relative weights (or ratio) placed on professional's forecasts is also higher during these periods.

If consensus forecasts and actual inflation rate converge to the same long run value, formula (7) for the steady state expected inflation will again be valid here. It is noteworthy that the last two lines of each panel in Table 9 show that the inclusion of nonlinear effects – vanishing in the long run under the assumption of unbiasedness of the consensus forecasts – lowers the long run level of households' expected inflation, though it is still permanently above the ECB target of 2%.

4.3. Discussion and summary of results

The empirical analyses consider key issues relating to households forming inflation expectations. Specifically, their 'anchoring' and 'absorption' behavior and how this can vary demographically. As highlighted in the introductory section, the present analysis considers two strands in the literature: the role of central bank inflation targeting and learning from experts.

The results clearly indicate that Italian households do not anchor on ECB inflation targets. In the short-run, they are excessively sensitive to their perception of current inflation rates. Furthermore, in the long-run, they anchor their expectations on professionals' forecasts. This would be a costly option for households, except if they deem the ECB's inflation targets to lack credibility. Interestingly, while the long-run professionals' inflation expectations approximate the ECB targets, the households' long-run expectations are considerably higher. Households tend to set the professionals' forecasts at a ratio greater than one.

The estimates also indicate significant differences between the different demographic groups' long-run expectations. The most pronounced of this is between the genders. Females have considerably higher inflation expectations than their male counterparts. Bryan and Venkatu (2001b) found that females had higher perceptions of inflation then males, and they also suggest number of possible reasons why this may arise. Females have different shopping patterns than men, both with respect to what they purchase (as females are more likely to do the household shopping), and with respect to the frequency of their purchases. Females are also deemed to be less knowledgeable of officially reported statistics. Nevertheless, these reasons remain speculative.

The absorption rates of households vary considerably too. Broadly, the higher the education level the higher is their absorption rate of the professionals' forecasts, because the most educated group has a better understanding of inflation forecasts and a wider access to mass media which report them. If the transmission of the relevant information takes place socially, it is likely that this group will have professional and social networks that are equally knowledgeable.

An important aspect of the present analyses is to investigate the non-linear behavior of households when forming inflation expectations. Similar to Carroll (2003) and Lanne eta al (2009), we consider the role of current inflation rates. Unlike previous research, we consider the non-liner impact of current inflation signals. We find that inflation signals are important to households as they are interested in the future direction of inflation rates, that is its momentum. Indeed, they respond asymmetrically. All households absorption rates and their reactivity to consensus forecasts increase considerably during periods when consensus future inflation is higher than the present one. Akerlof et al (1996 and 2000) argue that households are more concerned about rising inflation as this would be more costly to them, because rising inflation usually leads to falling real wages.

5. Conclusions

The main purpose of the present paper is to consider a number of key issues relating to how households form their inflation expectations. While how households form their inflation expectations has increasingly received recent attention, the present analysis in considering their 'anchoring' behavior brings together two important strands of the existing literature. In the first instances, the role of central bank inflation targeting and, secondly, learning from experts. Using a novel household-based survey data we are also able to consider the demographic nature of households 'anchoring' behavior when forming their inflation expectations.

If rational consumers think that the cost of acquiring information is too high, they may update their information set with some lags, resulting to be "rational inattentive" (Reis, 2006a, 2006b); a specific form of 'sticky information' behavior may also derive from the delay according to which the general public absorb the forecasts of professional forecasters, in line with an 'epidemiologic' behavior (Carroll, 2003, 2006). According to a related strand of contributions, it is also possible that agents are excessively sensitive to transitory inflationary episodes, being however able to 'anchor' their long run expectations to the target set by monetary authorities (Bernanke, 2007).

In this paper, we have tried to provide new evidence on the inflation formation process using a unique dataset based on the ISAE consumers' survey for Italy. Since February 2003 the survey – realized in the framework of the Harmonised Project of the European Commission - provides a direct monthly measure of inflation perceptions and expectations, respectively referred to consumers' quantitative assessments on the evolution of consumer prices in the last 12 months and on their quantitative expectations for 12 months ahead. Data have been used to estimate a new model encompassing both the anchoring approach, derived as a long run solution, and the Carroll epidemic adjustment mechanism in the short run. In this sense, agents are found to adjust their expectations in the short run to changes in both the consensus forecasts and their own inflation perceptions (but not on actual inflation); however, a long-run level relationship between inflation expectations and consensus forecasts is necessary for the model to be a congruent representation of the data. Moreover, both the actual level of long run inflation expectations and the speed of adjustment to the long run solution are found to differ across groups of individuals: speed of adjustment towards the long run is growing with age and the level of education, being also higher for men than for women; similarly, long run inflation expectations are also heterogeneous among the various groups, being lower for males with higher education or being self employed, the 'gender gap' eventually decreasing with age. However, all the groups have in common a long run solution of the model well above the official target set by the European Central Bank.

The finding that inflation expectations are higher than actual inflation has already been documented in the literature for the US (van der Klauw et al., 2008). In the case of Italy, the fact that inflation expectations are higher than actual outcomes may be linked to a "change over" effect that started in the immediate aftermath of the adoption of the common currency and lasted for a long period thereafter (see also on this Del Giovane, Fabiani and Sabbatini, 2009). According to Bruine de Bruine et al. (2010), there is also the possibility that overestimation is linked to the design of the questionnaire: questions on “price in general” or “price you pay” are found to elicit higher expectations than those based on questions about the “rate of inflation” (and the ISAE questionnaire asks about “consumer prices”, which is a concept closer to that of “price in general” than to that of “rate of inflation”).

However, the finding that in the long run expectations are higher than the official ECB target calls into question the credibility of the monetary target: in the case of Italy, a possible interpretation is that households may not be sufficiently aware of the target, given the fact that this tool was not previously used by the national monetary authority. Italian consumers may choose to ‘anchor’ their long run expectations to a value that is higher than the official target, possibly over-reacting to professional forecasters: a first confirmation in this sense comes from the estimation of a non linear version the model, according to which households tend to respond asymmetrically to adjustments in professional forecasts, showing a greater reaction to positive than to negative gaps. Further research on this is however advisable in the future, possibly extending the analysis to other Euro Area countries, exposed to the same changeover shock, but with a different tradition in the conduct of monetary policies and the use of inflation targeting.

References

Akerlof, G, W. Dickens and G. Perry. (1996). "The macroeconomics of low inflation", *Brookings Paper in Economic Activity*, No. 1, pp. 1-76.

________. (2000). "Near-rational wage and price setting and the long-run Phillips curve,', *Brookings Paper in Economic Activity*, No. 1, pp. 1-60.

Ball, L, N. G. Mankiw, and R. Reis (2005), "Monetary Policy for Inattentive Economies", *Journal of Monetary Economics*, 52, 703-725.

Bernanke, B. S. (2007), "Inflation expectations and inflation forecasting", speech at the Monetary Economics Workshop of the NBER Summer Institute, available at http://www.federalreserve.gov/newsevents/speech/bernanke20070710a.htm

Blanchflower, D. G. and C. Mac Coille (2009), "The formation of inflation expectations: an empirical analysis for the UK", *Bank of England*, speech at http://www.bankofengland.co.uk/publications/speeches/2009/speech387.pdf

Branch, W.A. (2007), "Sticky information and model uncertainty in survey data on inflation expectations.", *Journal of Economics Dynamics and Control*, 31, 245-276.

Brian, M. F. and G. Venkatu (2001a), "The demographics of inflation opinion surveys", *Fed of Cleveland*, October.

__________________________ (2001b), "The curiously different inflation perspectives for men and women", *Fed of Cleveland*, November.

Bruine de Bruin, W., C. F. Manski, G. Topa, and W. Van der Klaauw (2009), "Measuring Consumer Uncertainty about Future Inflation". FRB of New York Staff Report No. 415, available at SSRN: http://ssrn.com/abstract=1525643

Bruine de Bruin, W., W. Van der Klaauw, J.S. Downs, B. Fischhoff, G. Topa, and O. Armantier (2010), "The Effect of Question Wording on Reported Expectations and Perceptions of Inflation", FRB of New York Staff Report No. 443, April, available at SSRN: http://ssrn.com/abstract=1594890

Carroll, C. D. (2003), Macroeconomic expectations of households and professional forecasters", The Quarterly Journal of Economics, February, 269-298.

________ (2006), "The Epidemiology of Macroeconomic Expectations" in Larry Blume and Steven Durlauf, eds., *The Economy as an Evolving Complex System, III*, Oxford University Press.

Del Giovane, P., S. Fabiani, R. Sabbatini R. (2009), "What's behind "inflation perceptions"? A survey-based analysis of Italian consumers", Giornale degli Economisti ed Annali di Economia, Vol. 68, No. 1, 53-80.

Im, K. S., H. M. Pesaran and Y. Shin (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics*, Vol. 115, 53-74.

Kelly, R. (2008), "The causal relationship between inflation and inflation expectations in the UK", *Bank of England Discussion Paper*, No. 24.

Lanne, M, A. Luoma and J. Luoto (2009), "A naive sticky information model of households' inflation expectations", *Journal of Economic Dynamics and Control*, Vol. 33, 1332-1344.

Levin, A. T., F. M. Natalucci and J. M. Piger (2004), "The macroeconomic effects of Inflation targeting", *Fed of St. Louis Review*, Vol. 86, No. 4, 51-80.

Lombardelli, C. and J. Saleheen (2003), "Public expectations of UK inflation", *Bank of England Quarterly Bulletin*, Autumn.

Malgarini, M. (2009), "Quantitative inflation perceptions and expectations of Italian consumers", *Giornale degli Economisti e Annali di Economia*, Vol. 68, No. 1, 53-80.

Malgarini, M., M. Pugno and G. Zezza (2009), "Life satisfaction in Italy: evidence from the ISAE consumers survey", *ISAE Working Paper*, No. 121

Mankiw, N. G. and R. Reis (2002), "Sticky Information Versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve", *Quarterly Journal of Economics,* 117, 1295-1328.

_______ (2007), "Sticky Information in General Equilibrium", *Journal of the European Economic Association,5,* 603-613.

Mankiw, N. G., R. Reis and J. Wolfers (2004), "Disagreement about Inflation Expectations", *NBER Macroeconomics Annual 2003,* 18, 209-270.

Pesaran, M. H., Y. Shin and R. J. Smith (2001), "Bounds testing approaches to the analysis of long run relationships", *Journal of Applied Econometrics*, Vol. 16, 289-326.

Pesaran, M. H., Y. Shin and R. P. Smith (1999), "Pooled mean group estimation of dynamic heterogeneous panels", *Journal of the American Statistical Association*, Vol. 94, No. 446, 621-634.

Reis, R. (2006a), "Inattentive consumers", *Journal of Monetary Economics*, Vol. 53, 1761–1800.

_______ (2006b), "Inattentive producers", *Review of Economic Studies*, Vol. 73, 793–821.

Van der Klaauw, W., W. Bruine de Bruin, G. Topa, S. Potter, and M.F. Bryan (2008), "Rethinking the Measurement of Household Inflation Expectations: Preliminary Findings", FRB of New York Staff Report No. 359, December, available at SSRN: http://ssrn.com/abstract=1320196

Verbeek, M. and T. Nijman (1992), "Can cohort data be treated as genuine panel data?", *Empirical Economics*, Vol. 17, No. 1, 9-23.

White, H. (1980), "A heteroskedastic-consistent covariance matrix estimator and a direct test for heteroskedasticity", *Econometrica*, Vol. 48, 817-838.

Appendix A1 - The inflation forecast consensus estimate

Since 1999, we collected the annual forecasts of the inflation rate – denoted as: $E^F_{t,r}\dot{p}_{t+h}$ – for the current year (based on partial information about developments in that year) and for the following year (i.e. h = 0, 1) of five different forecast institutes F, i.e. professional forecasters.[16] Such forecasts are reported and largely commented in the press at month r of year t in which they are published.[17] In this way, the institutes' forecasts are (intermittently) published only for some months r of each year t , while ISAE households' survey is regularly conducted for each month m.

In order to obtain monthly series of professional forecasters, in the month when the forecast of the F^{th} institute is published (i.e. $m = r$), we assume that the inflation forecast over the next twelve months is given by the weighted average of current- and next-year inflation forecasts:

$$E^F_t(\pi_{t+1}) = \frac{12-m}{12} E^f_{t,r}\dot{p}_t + \frac{m}{12} E^f_{t,r}\dot{p}_{t+1}\,.$$

The two weights for t and $t+1$ forecasts are respectively proportional to the number of moths from m to the end of the current year, and to the remaining months of the following year. If in the following month the F^{th} institute does not publish a new forecast, the F monthly prediction in $m+1$ is assumed to be equal to the most recent forecasts for t and $t+1$ ($E^F_{t,r}\dot{p}_{t+h}$) averaged with updated weights: $\frac{12-m-1}{12}$ and $\frac{m+1}{12}$; note that weights always sum to one.

Figure A1 depicts the five monthly inflation forecasts over the period of interest. Though the different forecasts broadly tend to follow a similar path over time, the visual inspection of Figure A1 suggests that there are more "noisy" periods, in which the professional forecasters tend to disagree to a larger extent.

Figure A1 here

[16] The five professional forecasters are three Italian institutes (Ricerche per l'Economia e la Finanza, Associazione Prometeia per le Previsioni Econometriche, and Istituto di Studi e Analisi Economiche), and two international organizations (IMF's World Economic Outlook, and OECD's Economic Outlook). They are respectively labeled as F = *ref*, *pro*, *isae*, *weo*, and *eco*.

[17] With few exceptions, *ref* and *pro* publish their forecasts four times per year (i.e. r = January or February, April or May, September or October, and December), while the other three institutes report the inflation forecasts twice per year: r = February and May for *isae*, r = May and October for *weo*, and r = June and December for *eco*.

In order to compute a monthly consensus series, we take the average of the five institutes' forecasts. Further, we define the series which measures the noise that mixes up the forecast signal as the monthly standard deviation of the five forecasts. Both series are reported in Figure A2.

The vision of Figure A2 suggests that the consensus inflation forecast witnesses a rapid increase from the end of 2007 to the first half of 2008, then rapidly drops to about 1% during 2009. Regarding noise, we note that institutes' disagreement peaked during the last period of the sample, i.e. when the inflation forecasts started to move away from the 2-2.3% range typical of the first part of the sample.

Figure A2 here

Tab. 1

Expected inflation: sample composition and statistics by selected characteristics

	# obs.	% share	mean	std. dev.	% points deviation from reference group [a, b]	
	(1)	(2)	(3)	(4)	(5) [c]	(6) [d]
Employment						
- self-employed	10288	8.9	4.6	10.8	-1.036 ***	-1.004 ***
- white collar	29687	25.6	5.6	12.2		
- blue collar	11684	10.1	6.6	13.8	0.557 ***	0.487 ***
- pensioner	31916	27.6	5.1	11.7	0.178	0.205
- other [e]	32214	27.8	6.2	13.8	0.334 **	0.295 **
Education						
- university	11918	10.3	4.9	10.9	-0.385 ***	-0.316 ***
- upper secondary	45514	39.3	5.5	12.3		
- lower secondary	35757	30.9	6.0	13.1	0.587 ***	0.627 ***
- elementary	22600	19.5	5.7	13.1	0.931 ***	0.987 ***
Gender						
- male	57824	49.9	5.3	11.7		
- female	57965	50.1	6.0	13.4	0.482 ***	0.510 ***
Age						
- < 30	11138	9.6	6.3	14.0	0.113	0.071
- 30 – 49	40736	35.2	6.0	13.1		
- 50 – 64	33629	29.0	5.6	12.4	-0.733 ***	-0.685 ***
- > 64	30286	26.2	4.9	11.5	-1.767 ***	-1.655 ***
Full sample	115789	100.0	5.6	12.6	5.621 ***	5.659 ***

([a]) The reference group is: white collar employee, upper secondary educated, male, and aged 30-49.

([b]) *** and ** respectively denote 1% and 5% significant differences. Parameters' standard errors are robust to heteroschedasticity, see White (1980).

([c]) OLS estimates of a model with constant (equal to 5.621) and dummy variables for individual characteristics.

([d]) OLS estimates of a model with time effects (whose average estimate is 5.659) and dummy variables for individual characteristics.

([e]) Unemployed, student or housewife.

Tab. 2
Main outcomes from estimating three alternative models for repeated cross-sections

	Model with: [a]		
	only individual characteristics	plus time effects	plus perceived inflation, consensus, and interactions
P-values of joint zero restrictions to: [b]			
individual characteristics	0.0000	0.0000	0.1247
- employment	0.0000	0.0000	0.5458
- education	0.0000	0.0000	0.0112
- gender	0.0000	0.0000	0.1324
- age	0.0000	0.0000	0.8187
time effects		0.0000	0.0000
interaction of individual characteristics with			
perceived inflation			0.0000
- employment			0.0000
- education			0.0544
- gender			0.2819
- age			0.0434
consensus forecast			0.0022
- employment			0.1565
- education			0.0001
- gender			0.1944
- age			0.9605
R^2	0.0044	0.1868	0.2984
# parameters	12	95	118

([a]) The first model is the same as that reported in column (5) of Table 1; the second model is the same as that reported in column (6) of Table 1.

([b]) Inferences are robust to heteroschedasticity as standard errors are computed using White (1980) formulae.

Tab 3

From general to specific estimates of ARDL models (4)-(5) [a]

	(1)	(2)	(3)	(4)
Short run parameter estimates:				
λ_{11}	2.1589	2.9204	2.9386	2.8935
	1.163	1.0454	1.0359	1.0214
	1.86	2.79	2.84	2.83
λ_{12}	0.1982	0.2031	0.2012	0.2022
	0.0462	0.0462	0.0452	0.0448
	4.29	4.39	4.45	4.51
λ_{13}	0.0265			
	0.0535			
	0.50			
λ_2	-0.3164	-0.3032	-0.3005	-0.2931
	0.0757	0.0755	0.0741	0.0704
	-4.18	-4.02	-4.06	-4.16
Long run parameter estimates				
ϕ_1	2.6132	3.0539	3.228	2.9028
	1.2094	1.2224	0.9517	0.1569
	2.16	2.50	3.39	18.51
ϕ_2	0.005	0.0121		
	0.0508	0.0527		
	0.10	0.23		
ϕ_3	0.3303			
	0.2253			
	1.47			
$\phi_4 \pi^T$	-0.2369	-0.5756	-0.6746	
	1.9325	1.9955	1.9488	
	-0.12	-0.29	-0.35	
T	82	82	82	82
R^2	0.38653	0.36455	0.36412	0.36550
RMSE	0.84942	0.85305	0.84778	0.84295
Long run solution of expected inflation [b, c]				
upper bound			6.4269	6.3862
			0.3583	0.3451
lower bound			5.1357	5.2251
			0.3788	0.2823
point estimate			5.7813	5.8056
			0.3158	0.3137

([a]) Standard errors are below each estimate and, below standard errors, the t-statistics.

([b]) Obtained from equation (7) assuming $E^F(\pi^*)$ = 1.8 and 2.2 in equation (6).

([c]) Standard errors are below each long run estimate.

Tab 4
Alternative group definitions [a]

	Male	Female	Working	Not working
	panel # 2		***panel # 1***	
University	1 (5.0)	2 (4.3)	1 (6.7)	2 (2.5)
Upper secondary	3 (19.2)	4 (16.9)	3 (22.0)	4 (14.1)
Lower secondary	5 (15.5)	6 (15.5)	5 (10.8)	6 (20.1)
Elementary	7 (8.4)	8 (15.4)	7 (23.8)	
	panel # 3			
Self-employed	1 (5.9)	2 (2.3)		
White collar	3 (12.9)	4 (10.2)		
Blue collar	5 (6.5)	6 (3.2)		
Pensioner	7 (18.3)	8 (11.8)		
Other [b]	9 (4.3)	10 (24.6)		
	panel # 4			
Age < 30	1 (4.5)	5 (3.9)		
30 – 49	2 (15.6)	6 (16.9)		
50 – 64	3 (14.0)	7 (14.9)		
> 64	4 (13.8)	8 (16.5)		

([a]) For each panel, the number that labels each group is reported together with, in brackets, the % frequency of the group on the total surveyed people. The sum of % frequencies by panel may be not exactly equal to 100 for rounding effects.

([b]) Unemployed, student or housewife.

Tab 5
Main estimation results, pseudo panel # 1 [a]

groups: [a]	1	2	3	4	5	6	7
estimates [b] and tests [c]:							
Unrestricted model (8)							
λ_2^h	-0.6540	-0.7918	-0.4184	-0.5300	-0.6135	-0.3188	-0.3254
t	-6.83	-7.12	-4.57	-5.28	-5.98	-3.86	-3.98
$\phi_2^h = \phi_3^h = 0$	0.1307	0.2551	0.0538	0.2100	0.4177	0.7773	0.9281
$\lambda_{13}^h = 0$	0.8584	0.8123	0.0595	0.7053	0.5212	0.1287	0.5058
$\lambda_{13}^h = \phi_2^h = \phi_3^h = 0$	0.0828	0.1305	0.0793	0.3055	0.1078	0.4368	0.7819
Restricted model (9)							
λ_{11}^h	5.7023	4.5751	1.8873	4.8078	5.3597	3.5306	3.7333
t	3.78	1.63	1.3	3.23	2.79	2.42	2.58
λ_{12}^h	0.2075	0.2214	0.2335	0.1116	0.1521	0.2091	0.1238
t	5.35	4.6	5.03	2.19	2.92	4	3.19
λ_2^h	-0.6368	-0.7846	-0.3625	-0.49	-0.6234	-0.3296	-0.3184
t	-6.55	-7.04	-4.03	-5.02	-6.08	-4.06	-4.06
ϕ_1^h	2.6345	3.0698	3.4127	3.2927	3.9601	4.0098	3.413
t	4.11	3.21	3.25	3.96	4.74	3.29	2.68
$\phi_4^h \pi^T$ [d]	-0.0905	-1.2499	-1.244	-0.9789	-1.7591	-1.9601	-0.9697
t	-0.07	-0.64	-0.58	-0.58	-1.03	-0.79	-0.37
R^2	0.5332	0.5716	0.3925	0.3149	0.4042	0.3983	0.3161
$\phi_1^h = \phi_1$	0.8990						
PMG model (10)							
λ_{11}^h	5.8098	4.6084	1.8510	4.7988	5.1525	3.4500	3.7181
t	3.96	1.70	1.33	3.34	2.77	2.44	2.66
λ_{12}^h	0.2059	0.2215	0.2340	0.1168	0.1539	0.2120	0.1241
t	5.45	4.75	5.22	2.26	3.03	4.19	3.31
λ_2^h	-0.6407	-0.7849	-0.3590	-0.4892	-0.6023	-0.3183	-0.3174
t	-6.76	-7.26	-4.24	-5.22	-6.2	-4.13	-4.2
ϕ_1	3.2458	3.2458	3.2458	3.2458	3.2458	3.2458	3.2458
t	9.70	9.70	9.70	9.70	9.70	9.70	9.70
$\phi_4^h \pi^T$ [d]	-1.3245	-1.6048	-0.9072	-0.8841	-0.3165	-0.4166	-0.6301
t	-1.79	-2.06	-1.13	-1.17	-0.43	-0.52	-0.78
Long run interval: [e]							
- upper bound	5.82	5.54	6.23	6.26	6.82	6.72	6.51
- lower bound	4.52	4.24	4.94	4.96	5.53	5.43	5.21

([a]) The groups definition of panel # 1 is in Table 4.
([b]) Maximum likelihood estimates (below, the corresponding Student-t statistics).
([c]) When in the first column there is a restriction, p-values under such null hypothesis are reported.
([d]) Obtained as a ratio of PMG parameters' estimates: $-\lambda_{10}^h / \lambda_2^h$.
([e]) Interval estimation of inflation expectations (steady state of the model with unconstrained intercepts).

Tab 6
Main estimation results, pseudo panel # 2 [a]

groups: [a]	1	2	3	4	5	6	7	8
estimates[b] and tests[c]:								
Unrest. model (8)								
λ_2^h	-0.7618	-0.7508	-0.4800	-0.5118	-0.4735	-0.4316	-0.4932	-0.3769
t	-7.53	-6.78	-5.41	-5.04	-5.06	-4.65	-4.92	-4.25
$\phi_2^h = \phi_3^h = 0$	0.1002	0.1791	0.0465	0.2547	0.8248	0.5757	0.5689	0.8836
$\lambda_{13}^h = 0$	0.7224	0.5953	0.2565	0.1010	0.8045	0.2238	0.4503	0.3303
$\lambda_{13}^h = \phi_2^h = \phi_3^h = 0$	0.0127	0.2367	0.0738	0.2572	0.7530	0.6149	0.6777	0.5724
Restricted model (9)								
λ_{11}^h	7.2105	3.7993	2.5254	3.8954	4.9954	2.9761	4.0459	3.8449
t	4.14	1.71	1.84	2.52	3.08	1.87	2.15	2.15
λ_{12}^h	0.1812	0.1767	0.3089	0.1495	0.2095	0.1561	0.0635	0.1137
t	3.44	3.68	5.67	3.43	3.40	3.40	1.64	2.76
λ_2^h	-0.7509	-0.7340	-0.4132	-0.4928	-0.4666	-0.4341	-0.4753	-0.3733
t	-7.24	-6.67	-4.86	-4.91	-5.10	-4.76	-4.95	-4.35
ϕ_1^h	2.5335	3.0901	3.2637	3.5796	4.0796	4.0073	3.7910	3.4631
t	4.11	3.72	3.64	4.32	4.26	3.97	3.39	2.60
$\phi_4^h \pi^T$ [d]	-0.5456	-0.4708	-1.4177	-0.9496	-2.2409	-1.6860	-1.6213	-1.1657
t	-0.43	-0.28	-0.77	-0.56	-1.14	-0.82	-0.71	-0.43
R^2	0.4932	0.4820	0.4561	0.3500	0.4162	0.3606	0.2803	0.3102
$\phi_1^h = \phi_1$	0.862							
PMG model (10)								
λ_{11}^h	7.3357	3.8366	2.5300	3.8169	4.8662	2.8665	3.9747	3.8272
t	4.31	1.78	1.92	2.57	3.10	1.86	2.19	2.21
λ_{12}^h	0.1798	0.1763	0.3088	0.1502	0.2125	0.1585	0.0643	0.1139
t	3.48	3.78	5.85	3.56	3.55	3.57	1.71	2.86
λ_2^h	-0.7501	-0.7349	-0.4136	-0.4851	-0.4474	-0.4215	-0.4688	-0.3727
t	-7.39	-6.89	-5.10	-5.10	-5.19	-4.84	-5.09	-4.49
ϕ_1	3.2885	3.2885	3.2885	3.2885	3.2885	3.2885	3.2885	3.2885
t	10.66	10.66	10.66	10.66	10.66	10.66	10.66	10.66
$\phi_4^h \pi^T$ [d]	-2.0688	-0.8711	-1.4678	-0.3620	-0.6410	-0.2357	-0.6078	-0.8135
t	-2.89	-1.26	-1.93	-0.53	-0.88	-0.33	-0.82	-1.04
Long run interval: [e]								
- upper bound	5.17	6.36	5.77	6.87	6.59	7.00	6.63	6.42
- lower bound	3.85	5.05	4.45	5.56	5.28	5.68	5.31	5.11

([a]) The groups definition of panel # 1 is in Table 4.
([b]) Maximum likelihood estimates (below, the corresponding Student-t statistics).
([c]) When in the first column there is a restriction, p-values under such null hypothesis are reported.
([d]) Obtained as a ratio of PMG parameters' estimates: $-\lambda_{10}^h / \lambda_2^h$.
([e]) Interval estimation of inflation expectations (steady state of the model with unconstrained intercepts).

Tab 8
Main estimation results, pseudo panel # 4 [a]

groups: [a]	1	2	3	4	5	6	7	8
estimates[b] and tests[c]:								
Unrest. model (8)								
λ_2^h	-0.7005	-0.5743	-0.4717	-0.4533	-0.7846	-0.5661	-0.4427	-0.2550
t	-6.92	-5.92	-5	-4.68	-7.2	-5.47	-4.9	-3.38
$\phi_2^h = \phi_3^h = 0$	0.1694	0.0983	0.1792	0.7703	0.6171	0.3605	0.5079	0.7890
$\lambda_{13}^h = 0$	0.7756	0.4130	0.7826	0.7370	0.7249	0.0464	0.3008	0.2961
$\lambda_{13}^h = \phi_2^h = \phi_3^h = 0$	0.0597	0.1261	0.0843	0.8872	0.7578	0.2159	0.6237	0.3156
Restricted model (9)								
λ_{11}^h	10.0266	4.0912	1.9034	5.5843	3.8037	5.6072	3.2280	0.9443
t	4.29	2.61	1.20	3.73	1.26	3.60	2.10	0.67
λ_{12}^h	0.1764	0.3074	0.2295	0.0468	0.2075	0.1022	0.1813	0.1550
t	3.05	5.29	4.17	0.87	3.53	2.49	3.93	4.15
λ_2^h	-0.6831	-0.5246	-0.4342	-0.4430	-0.7787	-0.5902	-0.4228	-0.2524
t	-6.61	-5.56	-4.78	-4.73	-7.25	-5.78	-4.89	-3.44
ϕ_1^h	3.9701	3.5076	3.3102	3.6717	3.8477	3.8145	3.5087	3.1717
t	4.36	4.53	3.27	3.84	3.50	5.39	3.51	1.99
$\phi_4^h \pi^T$ [d]	-2.1814	-1.3775	-1.3116	-2.2668	-0.3424	-1.0230	-0.9812	-1.2679
t	-1.17	-0.87	-0.63	-1.16	-0.15	-0.71	-0.48	-0.39
R^2	0.4678	0.4920	0.3755	0.3415	0.5122	0.3845	0.3550	0.3049
$\phi_1^h = \phi_1$	0.998							
PMG model (10)								
λ_{11}^h	9.9187	4.1251	1.9468	5.5816	3.7661	5.5656	3.2466	0.9713
t	4.41	2.73	1.27	3.86	1.29	3.70	2.19	0.71
λ_{12}^h	0.1769	0.3071	0.2284	0.0470	0.2079	0.1025	0.1810	0.1542
t	3.15	5.46	4.29	0.90	3.65	2.57	4.06	4.27
λ_2^h	-0.6758	-0.5273	-0.4359	-0.4429	-0.7780	-0.5862	-0.4238	-0.2515
t	-6.87	-5.82	-4.95	-4.89	-7.47	-5.98	-5.07	-3.54
ϕ_1	3.6474	3.6474	3.6474	3.6474	3.6474	3.6474	3.6474	3.6474
t	11.37	11.37	11.37	11.37	11.37	11.37	11.37	11.37
$\phi_4^h \pi^T$ [d]	-1.5303	-1.6601	-1.9919	-2.2178	0.0618	-0.6861	-1.2612	-2.2287
t	-2.01	-2.14	-2.40	-2.58	0.08	-0.97	-1.63	-2.17
Long run interval: [e]								
- upper bound	6.49	6.36	6.03	5.81	8.09	7.34	6.76	5.80
- lower bound	5.04	4.91	4.57	4.35	6.63	5.88	5.30	4.34

([a]) The groups definition of panel # 1 is in Table 4.

([b]) Maximum likelihood estimates (below, the corresponding Student-t statistics).

([c]) When in the first column there is a restriction, p-values under such null hypothesis are reported.

([d]) Obtained as a ratio of PMG parameters' estimates: $-\lambda_{10}^h / \lambda_2^h$.

([e]) Interval estimation of inflation expectations (steady state of the model with unconstrained intercepts).

Tab 7
Main estimation results, pseudo panel # 3 [a]

groups: [a] estimates [b] and tests [c]:	1	2	3	4	5	6	7	8	9	10
Unrestricted model (8)										
λ_2^h	-0.6194	-0.8434	-0.4952	-0.5741	-0.4419	-0.8640	-0.4225	-0.3128	-0.8201	-0.4482
t	-5.50	-7.45	-5.24	-5.65	-4.66	-7.37	-4.64	-3.74	-8.08	-4.73
$\phi_2^h = \phi_3^h = 0$	0.1306	0.4740	0.1660	0.1664	0.4202	0.6191	0.6115	0.8121	0.2201	0.5831
$\lambda_{13}^h = 0$	0.5138	0.5798	0.7458	0.2214	0.1966	0.4885	0.6947	0.7429	0.8787	0.2040
$\lambda_{13}^h = \phi_2^h = \phi_3^h = 0$	0.0166	0.3589	0.1855	0.2636	0.4645	0.7339	0.5808	0.8351	0.2141	0.5808
Restricted model (9)										
λ_{11}^h	3.6126	2.3083	3.7409	5.0072	2.1202	4.4662	4.5711	1.6796	8.5913	3.6389
t	1.89	1.2	2.29	2.74	1.1	1.55	3.26	1.06	3.75	2.43
λ_{12}^h	0.1015	0.0911	0.2756	0.1614	0.2691	0.0273	0.1657	0.1259	0.211	0.1283
t	2.2	2.42	4.97	3.48	5.64	0.6	2.8	3.11	3.9	3.01
λ_2^h	-0.6405	-0.8271	-0.4474	-0.5506	-0.4006	-0.8595	-0.4001	-0.3021	-0.7785	-0.4473
t	-5.58	-7.51	-4.93	-5.46	-4.44	-7.46	-4.55	-3.79	-7.8	-4.83
ϕ_1^h	3.1596	3.0057	3.1281	3.6441	3.5226	4.8426	3.8538	2.6527	2.7275	4.0256
t	4.03	4.61	3.12	4.1	2.83	5.21	3.91	1.8	3.37	4.33
$\phi_4^h \pi^T$ [d]	-1.8287	-1.0989	-0.9498	-0.986	-0.579	-2.9598	-2.4037	-0.0264	0.508	-1.6925
t	-1.14	-0.82	-0.46	-0.54	-0.23	-1.56	-1.19	-0.01	0.31	-0.89
R^2	0.3439	0.4670	0.4570	0.3900	0.4561	0.4262	0.3624	0.2487	0.5764	0.3464
$\phi_1^h = \phi_1$	0.856									
PMG model (10)										
λ_{11}^h	3.6590	2.3665	3.7886	4.9392	2.0935	3.9825	4.5166	1.7290	8.7260	3.5478
t	1.97	1.27	2.40	2.81	1.13	1.41	3.34	1.12	3.92	2.45
λ_{12}^h	0.1013	0.0910	0.2748	0.1621	0.2695	0.0311	0.1681	0.1245	0.2107	0.1296
t	2.27	2.49	5.12	3.61	5.85	0.70	2.94	3.17	4.00	3.14
λ_2^h	-0.6423	-0.8222	-0.4510	-0.5448	-0.3988	-0.8189	-0.3928	-0.2994	-0.7817	-0.4367
t	-5.78	-7.70	-5.17	-5.69	-4.66	-7.41	-4.68	-3.88	-8.05	-4.92

ϕ_1		3.4002	3.4002	3.4002	3.4002	3.4002	3.4002	3.4002	3.4002	3.4002	3.4002
t		12.06	12.06	12.06	12.06	12.06	12.06	12.06	12.06	12.06	12.06
$\phi_4^h \pi^T$ [d]		-2.3141	-1.8950	-1.4995	-0.4935	-0.3321	-0.0517	-1.4869	-1.5353	-0.8489	-0.4310
t		-3.10	-2.93	-2.05	-0.76	-0.47	-0.08	-1.99	-1.82	-1.33	-0.65
Restrictions to PMG											
	0.0000	5.17	5.59	5.98	6.99	7.15	7.43	5.99	5.95	6.63	7.05
	0.0000	3.81	4.23	4.62	5.63	5.79	6.07	4.63	4.58	5.27	5.69

([a]) The groups definition of panel # 1 is in Table 4.

([b]) Maximum likelihood estimates (below, the corresponding Student-t statistics).

([c]) When in the first column there is a restriction, p-values under such null hypothesis are reported.

([d]) Obtained as a ratio of PMG parameters' estimates: $-\lambda_{10}^h / \lambda_2^h$.

([e]) Interval estimation of inflation expectations (steady state of the model with unconstrained intercepts).

Tab 9
Nonlinear modeling: main estimation results with all pseudo panels [a]

groups: [a] estimates [b] and tests [c]:	1	2	3	4	5	6	7	8	9	10
panel # 1										
Extending PMG (10) to linear gap effects [d]										
- long run pooled gap effect = 0	0.2726									
- long and short run gap effects = 0	0.5456	0.4513	0.1731	0.5424	0.5231	0.2330	0.2763			
Non-linear gap effects PMG model (12)										
- long run asymmetry: $\phi_5 + \phi_6 = 0$	0.7789									
- short run gap effect: $\lambda_{14}^h = 0$	0.4260									
- nonlinear dynamics: $\lambda_{2N}^h = \lambda_{2N}$	0.7505									
- joint LR test of the restrictions above	0.7745									
Restricted nonlinear PMG model (13)										
λ_{2P}^h	-0.7517	-0.8622	-0.4927	-0.6279	-0.7725	-0.4153	-0.3932			
	-7.11	-7.17	-5.08	-5.77	-6.8	-4.55	-4.19			
$\lambda_{2P}^h + \lambda_{2N}$	-0.5767	-0.6871	-0.3176	-0.4528	-0.5974	-0.2402	-0.2181			
	-5.29	-5.59	-3.17	-4.08	-5.18	-2.55	-2.22			
$\phi_{1P} = \phi_1 + \phi_5$ [e]	3.8762	3.8762	3.8762	3.8762	3.8762	3.8762	3.8762			
	11.43	11.43	11.43	11.43	11.43	11.43	11.43			
inflation effect when gap>0 = $-\phi_5$ [e]	-0.5903	-0.5903	-0.5903	-0.5903	-0.5903	-0.5903	-0.5903			
	-5.97	-5.97	-5.97	-5.97	-5.97	-5.97	-5.97			
$\phi_{1N} = \phi_1$	3.2859	3.2859	3.2859	3.2859	3.2859	3.2859	3.2859			
	10.48	10.48	10.48	10.48	10.48	10.48	10.48			
Long run expected inflation bound: [f]										
- upper	4.86	4.61	5.24	5.23	5.74	5.68	5.47			
- lower	3.55	3.29	3.92	3.92	4.43	4.37	4.15			
panel # 2										
Extending PMG (10) to linear gap effects [d]										
- long run pooled gap effect = 0	0.4534									
- long and short run gap effects = 0	0.7174	0.6952	0.2954	0.7164	0.3967	0.7230	0.3938	0.1436		

Non-linear gap effects PMG model (12)										
- long run asymmetry: $\phi_5 + \phi_6 = 0$	0.7357									
- short run gap effect: $\lambda_{14}^h = 0$	0.3941									
- nonlinear dynamics: $\lambda_{2N}^h = \lambda_{2N}$	0.7708									
- joint LR test of the restrictions above	0.7235									
Restricted nonlinear PMG model (13)										
λ_{2P}^h	-0.9055	-0.8312	-0.5341	-0.6431	-0.6197	-0.5422	-0.5530	-0.4739		
	-7.65	-7.22	-5.66	-6.01	-6.03	-5.35	-4.96	-4.72		
$\lambda_{2P}^h + \lambda_{2N}$	-0.7296	-0.6553	-0.3582	-0.4672	-0.4439	-0.3663	-0.3772	-0.2980		
	-6.19	-5.54	-3.71	-4.25	-4.28	-3.55	-3.31	-2.89		
$\phi_{1P} = \phi_1 + \phi_5$ [e]	3.915	3.915	3.915	3.915	3.915	3.915	3.915	3.915		
	12.62	12.62	12.62	12.62	12.62	12.62	12.62	12.62		
inflation effect when gap>0 = $-\phi_5$ [e]	-0.5903	-0.5903	-0.5903	-0.5903	-0.5903	-0.5903	-0.5903	-0.5903		
	-6.53	-6.53	-6.53	-6.53	-6.53	-6.53	-6.53	-6.53		
$\phi_{1N} = \phi_1$	3.3246	3.3246	3.3246	3.3246	3.3246	3.3246	3.3246	3.3246		
	11.58	11.58	11.58	11.58	11.58	11.58	11.58	11.58		
Long run expected inflation bound: [f]										
- upper	4.28	5.35	4.79	5.80	5.54	5.90	5.59	5.38		
- lower	2.95	4.02	3.46	4.47	4.21	4.57	4.26	4.05		
panel # 3										
Extending PMG (10) to linear gap effects [d]										
- long run pooled gap effect = 0	0.5365									
- long and short run gap effects = 0	0.6404	0.1437	0.2191	0.8241	0.8244	0.5702	0.6226	0.8246	0.5848	0.7196
Non-linear gap effects PMG model (12)										
- long run asymmetry: $\phi_5 + \phi_6 = 0$	0.5986									
- short run gap effect: $\lambda_{14}^h = 0$	0.7491									
- nonlinear dynamics: $\lambda_{2N}^h = \lambda_{2N}$	0.4715									
- joint LR test of the restrictions above	0.7544									
Restricted nonlinear PMG model (13)										
λ_{2P}^h	-0.7197	-0.9445	-0.5881	-0.7088	-0.4978	-1.0034	-0.5373	-0.3817	-0.9478	-0.5868
	-5.92	-8.05	-5.75	-6.62	-4.83	-7.89	-5.25	-4.20	-8.76	-5.57
$\lambda_{2P}^h + \lambda_{2N}$	-0.5310	-0.7558	-0.3995	-0.5201	-0.3092	-0.8148	-0.3486	-0.1931	-0.7591	-0.3982

	-4.27	-6.43	-3.87	-4.76	-2.93	-6.49	-3.37	-2.07	-6.95	-3.71
$\phi_{1P} = \phi_1 + \phi_5$ [e]	4.0466	4.0466	4.0466	4.0466	4.0466	4.0466	4.0466	4.0466	4.0466	4.0466
	14.22	14.22	14.22	14.22	14.22	14.22	14.22	14.22	14.22	14.22
inflation effect when gap>0 = $-\phi_5$ [e]	-0.6509	-0.6509	-0.6509	-0.6509	-0.6509	-0.6509	-0.6509	-0.6509	-0.6509	-0.6509
	-7.92	-7.92	-7.92	-7.92	-7.92	-7.92	-7.92	-7.92	-7.92	-7.92
$\phi_{1N} = \phi_1$	3.3958	3.3958	3.3958	3.3958	3.3958	3.3958	3.3958	3.3958	3.3958	3.3958
	12.91	12.91	12.91	12.91	12.91	12.91	12.91	12.91	12.91	12.91
Long run expected inflation bound: [f]										
- upper	4.21	4.57	4.88	5.82	5.91	6.21	4.89	4.80	5.56	5.85
- lower	2.85	3.21	3.53	4.46	4.55	4.85	3.54	3.44	4.20	4.49
panel # 4										
Extending PMG (10) to linear gap effects [d]										
- long run pooled gap effect = 0	0.6418									
- long and short run gap effects = 0	0.8961	0.8510	0.1259	0.4280	0.8584	0.7116	0.2280	0.8567		
Non-linear gap effects PMG model (12)										
- long run asymmetry: $\phi_5 + \phi_6 = 0$	0.2605									
- short run gap effect: $\lambda_{14}^h = 0$	0.3984									
- nonlinear dynamics: $\lambda_{2N}^h = \lambda_{2N}$	0.9502									
- joint LR test of the restrictions above	0.8375									
Restricted nonlinear PMG model (13)										
λ_{2P}^h	-0.8843	-0.6546	-0.5833	-0.6052	-0.8866	-0.7310	-0.5618	-0.3476		
	-7.34	-6.45	-5.64	-5.51	-7.56	-6.80	-5.64	-4.07		
$\lambda_{2P}^h + \lambda_{2N}$	-0.7071	-0.4774	-0.4061	-0.4280	-0.7094	-0.5538	-0.3846	-0.1704		
	-5.98	-4.56	-3.90	-3.87	-6.09	-4.97	-3.81	-1.93		
$\phi_{1P} = \phi_1 + \phi_5$ [e]	4.2951	4.2951	4.2951	4.2951	4.2951	4.2951	4.2951	4.2951		
	13.57	13.57	13.57	13.57	13.57	13.57	13.57	13.57		
inflation effect when gap>0 = $-\phi_5$ [e]	-0.6580	-0.6580	-0.6580	-0.6580	-0.6580	-0.6580	-0.6580	-0.6580		
	-7.15	-7.15	-7.15	-7.15	-7.15	-7.15	-7.15	-7.15		
$\phi_{1N} = \phi_1$	3.6371	3.6371	3.6371	3.6371	3.6371	3.6371	3.6371	3.6371		
	12.36	12.36	12.36	12.36	12.36	12.36	12.36	12.36		
Long run expected inflation bound: [f]										
- upper	5.44	5.28	4.98	4.79	6.82	6.20	5.60	4.74		
- lower	3.99	3.83	3.52	3.34	5.36	4.74	4.15	3.29		

([a]) The groups definition of panel # 1 is in Table 4.
([b]) Maximum likelihood estimates (below, the corresponding Student-t statistics).
([c]) When in the first column there is a restriction, p-values under such null hypothesis are reported.
([d]) Gaps are between the consensus forecasts and the latest available actual inflation release; p-values of variable addiction to model (9) .
([e]) Computed under the assumption that the consensus standard deviation is equal to one.
([f]) Interval estimation of long-run steady state households' inflation expectations.

Fig. A1 – Single-institute monthly forecasts

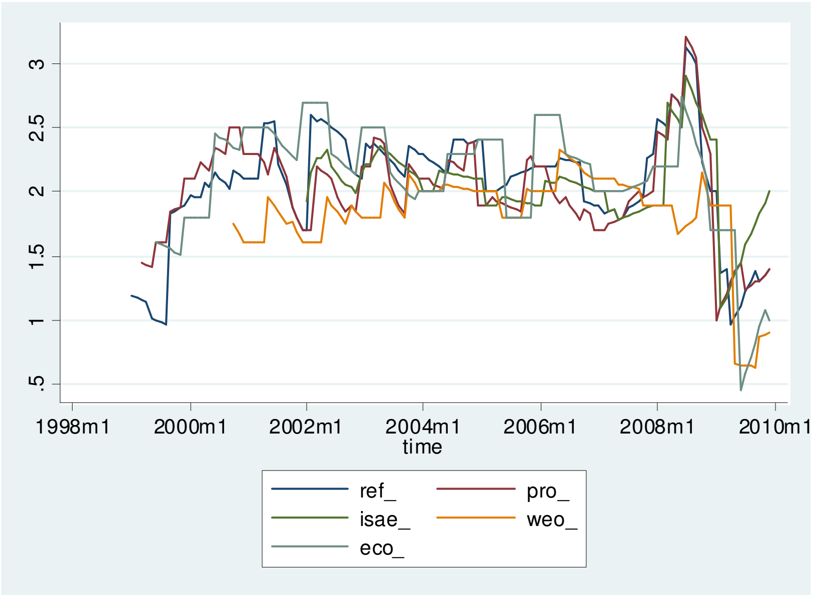

Fig. A2 – Inflation forecast consensus and noise