BANCA D'ITALIA
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Questioni di Economia e Finanza

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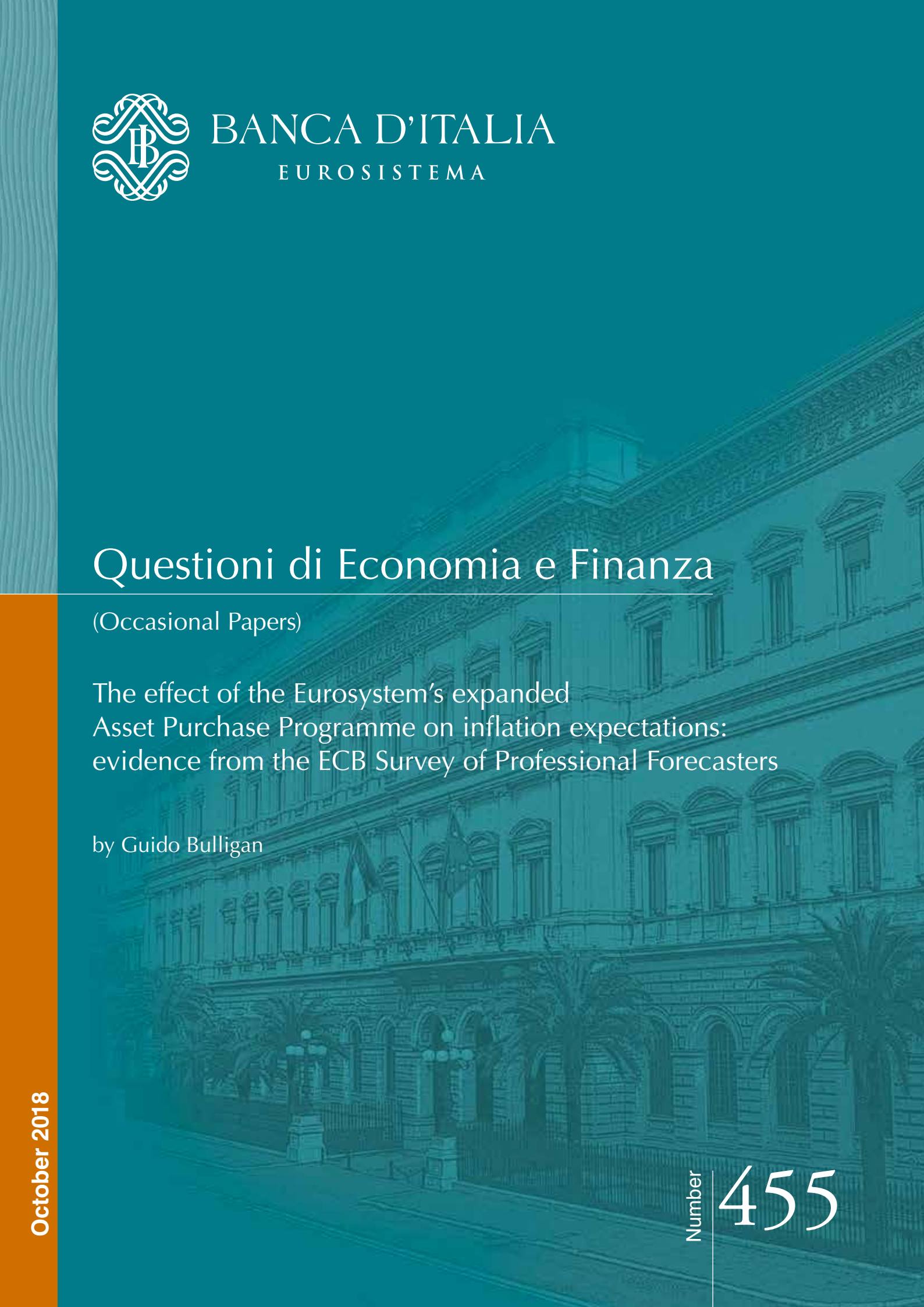
by Guido Bulligan



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The series is available online at www.bancaditalia.it .

ISSN 1972-6627 (print)
ISSN 1972-6643 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

THE EFFECT OF THE EUROSYSTEM'S EXPANDED ASSET PURCHASE PROGRAMME ON INFLATION EXPECTATIONS: EVIDENCE FROM THE ECB SURVEY OF PROFESSIONAL FORECASTERS

by Guido Bulligan*

Abstract

This paper investigates the effect of the ECB's asset purchases on inflation expectations in the euro area, as measured by the ECB Survey of Professional Forecasters. To identify the effects on individual expectations we adopt a panel approach, where the Eurosystem's Asset Purchase Programme (APP) shocks are used as covariates to explain the revisions in the individual inflation forecasts; controls for updates in macroeconomic and financial developments are also included. Our results indicate that the first APP announcement in January 2015 resulted in a statistically significant upward revision of medium term inflation expectations and lowered the forecasters' assessment of the probability of a low inflation regime. The average effect, however, masks significant differences among forecasters: forecasters that had been relatively more accurate prior to the announcement were also those who revised their inflation forecasts more markedly.

JEL Classification: E31, E52, E58, E65, G14.
Keywords: inflation expectations, monetary policy announcements, event study, unconventional monetary policy.

Contents

* Bank of Italy, Economic Outlook and Monetary Policy Directorate.

1 Introduction*

Inflation expectations play a crucial role in the transmission mechanism of monetary policy. For given expected nominal interest rate, higher (lower) inflation expectations mean lower (higher) real interest rates. Furthermore, well anchored long-term inflation expectations reduce the persistence of the response of actual inflation to temporary shocks. The role of agents' inflation expectations becomes even more important when nominal policy rates are near or at their lower bound. In this situation the degree of monetary policy accommodation depends on the expected path of future inflation prevailing in the economy. The key role of inflation expectations was particularly emphasized by the European Central Bank president Mario Draghi in his introductory statement to the ECB press conference on 22nd January 2015, when the expanded Asset Purchase Programme (APP) was announced; the programme was necessary to counteract *"a further fall in market-based measures of inflation expectations over all horizons and the fact that most indicators of actual or expected inflation stand at, or close to, their historical lows.[…] Thus, today the adoption of further balance sheet measures has become warranted to achieve our price stability objective, given that the key ECB interest rates have reached their lower bound."*

While asset purchases affect the economy through several transmission mechanisms (see for instance Cova and Ferrero (2015) for an overview), the inflation expectations channel impacts the economy most directly, by reducing the real cost of loans for households and firms. Despite its importance, this channel has not received much attention. For the euro area, Altavilla et al. (2015) look at the 2-day change in inflation swap rates at selected announcement dates and find that ECB policy announcements in the period between September 2014 and March 2015 raised market based inflation expectations at medium-term maturities (those between 2 and 5 years) by around 25 basis points. Bulligan and Delle Monache (2018) analyze the effects of ECB announcements over a longer sample and allow for the possibility that the effects are time-varying; according to their results, ECB unconventional monetary policy announcements significantly raised inflation expectations (measured by inflation swap rates at different horizons) over the period September 2014-July 2017, but with effects varying in magnitude (and statistical significance) over time. One limit of the analyses conducted with market prices is that the latter can be severely distorted by time-varying premia, which are most likely to react to policy announcements. Furthermore, policy decisions cannot be considered truly exogenous to aggregate variables, so that the resulting estimates, might be distorted. A way to reduce the endogeneity problem is to focus on individual expectations. The latter react to policy decisions (and other macroeconomic events) but policy decisions are not driven by (the idiosyncratic component of) individual expectations. Andrade et al. (2016) assess the impact of the Eurosystem's APP on survey based long-term inflation expectations. The authors look at revisions in median expectations collected quarterly by the ECB in its Survey of Professional Forecasters and find evidence of long-term inflation expectations readjusting towards higher levels following the policy announcement of 22nd January 2015. However, by focusing on the median expectation, Andrade et al. (2016) do not exploit the heterogeneity across forecasters, furthermore they do not control for common factors shifting both monetary policy and the median expectation, so that the positive effect on expectations the authors find could be due to other confounding factor such as concomitant macro releases. The omitted variable issue is particularly pressing in their set-up because unlike event studies with daily data, the analysis is carried out at the quarterly frequency so that revisions of expectations between consecutive quarters reflect a multitude of factors. Indeed, the lower the frequency of the data, the higher the probability that other factors may be driving the results. For this reason, in this paper, we reassess the effectiveness of the expectations channel of the APP by exploiting the individual specific information contained in the quarterly SPF survey, controlling for simultaneous changes in macroeconomic and financial conditions.

Our results indicate that the launch of the APP succeeded in raising inflation expectations. In particular, we find that the announcement led to an upward revisions in 2-year ahead inflation forecasts by 20 basis points

* I would like to thank Fabio Busetti and Davide Fantino for useful comments, any remaining errors are my own. The views expressed herein are those of the author and do not necessarily reflect those of the Institution he represents.

(on average across SPF respondents). We also find that the announcement shifted the individual probability distributions to the right: more precisely, it led to a reduction by around 10 percentage points of the probability associated with inflation falling between 0.0 and 0.9 per cent 2-year ahead and with an equivalent increase in the probability of inflation falling between 1.0 and 2.4 per cent. We also find that the average effect masks significant differences across forecasters subgroups. In particular we find that forecasters that had been relatively more accurate prior to the policy announcement revised their inflation forecast more strongly than less accurate forecasters. Our results support therefore the relevance of the expectations channel. Subsequent APP related announcements did not lead to a significant reassessment of price developments in the medium-term. This could be due to the fact that subsequent ECB recalibrations and extensions of the APP were not perceived by market participants as powerful or alternatively, the result could be due to the ability of the ECB to prepare markets well in advance of policy events in order to minimize the surprise component of its announcements[1]. Admittedly, the quarterly frequency of the SPF survey data does not allow to properly distinguish between these two possible explanations.

The structure of the paper is as follows: in Section 2 we introduce the ECB Survey of Professional Forecasters and describe its main characteristics; we then estimate the effects of announcements related to the ECB APP on the "average" SPF-forecaster. To do this we adopt a time series approach that differs from standard event study analyses only in the frequency of the observations (quarterly, rather than intra-daily or daily). Clearly, this poses a more serious challenge to the identification of the policy effects, given that over such time span many factors can move inflation expectations. On the other hand, unlike higher frequency analyses, we can be more confident that we capture the overall effect (including contemporaneous and lagged reactions of agents) of policy announcements and not only short-lived reactions. The analysis allows to review the main policy actions taken by the ECB and represents a preliminary assessment of their effectiveness on inflation expectations. In Section 3, we exploit individual heterogeneity to quantify the average effects of APP announcements on individual central inflation expectations and probability distributions. Finally we investigate the presence of heterogeneous effects based on individual characteristics.

2 The ECB SPF and the Eurosystem's Asset Purchase Programme: preliminary evidence

As stressed in the introduction, the existing empirical literature on the inflation expectations channel of unconventional monetary policy is mainly based on high frequency event studies looking at variations in market based inflation expectations. One main disadvantage of this approach is that market prices include premia of different nature. Such premia are not time invariant but move in response to policy decisions and other macroeconomic developments. If not properly accounted for, time-varying risk premia may distort the results based on market-based data. Furthermore, market prices reflects only aggregate (or "average") behavior and do not allow to study heterogeneity across individuals.

2.1 Overview of the ECB Survey of Professional Forecasters

The ECB Survey of Professional Forecasters is conducted at the beginning of each quarter. A panel of forecasters (the average number of participants has been 45 with a maximum of 61 and a minimum of 34) in the banking and finance industry as well as in non-financial research institutes and employers' and employees' organizations is questioned about their central expectations and probability distributions on euro

[1] For instance D'Amico et al. (2013) show that the impact of successive recalibration of the Federal Reserve LSAP programme on long term interest rates has not declined over time, once pre-announcement market expectations are properly controlled for.

area GDP growth, unemployment and inflation[2]. As to inflation, participants are asked about their point forecasts and probability distributions for the annual rate of change in the euro area HICP index at several horizons. In this paper we look at inflation expectations for the 2-year ahead horizon. The motivation behind this choice is twofold. First, as we are interested in the effects of unconventional monetary policies, we should consider medium- to long-term horizons, as these are more relevant for evaluating the effectiveness of monetary policy. Secondly, beyond the 8-quarter ahead horizon the SPF survey frequency switches from quarterly to annual frequency, preventing a proper identification of the effects of policy announcements from other confounding factors[3]. Indeed, omitted variables represent a non-negligible concern already at the quarterly frequency.

2.2 Preliminary aggregate evidence

We start by defining aggregate forecast revisions as consecutive changes in the median 8-quarter ahead inflation expectation and postulate that in the absence of "news" or "surprises" during the inter-SPF period, revisions should be zero. Clearly, several factors can explain forecast revisions and in our study we propose a simplified model where the main drivers, including unconventional monetary policy events, are included. In the analysis we focus on the 4 most important announcements made by the ECB regarding its expanded Asset Purchase Programme (APP). We selected the following dates: January 22nd 2015, when the APP was formally announced by president Draghi (APP_1), December 3rd 2015, when the first recalibration of the programme took place (APP_2), March 10th 2016, when the first extension and increase in size of monthly purchases were announced (APP_3) and finally December 8th 2016, when the ECB announced a second extension at a reduced monthly purchases (APP_4). Figure 1 plots the median (across individual forecasters) 8-quarter ahead inflation forecast: the squares represent the actual SPF forecast rounds (conducted at the beginning of each quarter) while the vertical bands correspond to the inter-SPF periods. The figure shows clearly that the "median SPF-forecaster" revised his expectation of inflation upwards following the ECB launch of the APP (APP_1). On the contrary, revisions following subsequent APP related policy announcements have been smaller. Similarly in figure 2 we report the evolution of the median probability associated by SPF respondents to two events: 1) that euro area inflation will lie between 0 and 0.9 pp in 8 quarters; 2) that HICP inflation will lie between 1.4 and 2pp. Once again, the squares represents SPF rounds. As in figure 1 in the SPF round of April 2015, which followed the ECB announcement of the APP in January 2015, the probability mass shifted from the [0-0.9] bracket to the [1.5-1.9] bracket. However, revisions in individual inflation forecast between consecutive rounds could be due to several factors, policy and non-policy related. Indeed, figure 3 clearly shows with some more historical perspective how SPF-inflation expectations tend to co-move with actual inflation realizations, oil-prices and to a lesser extent the bilateral EUR-USD exchange rate.

[2] Further details on the survey can be found at: https://www.ecb.europa.eu/stats/ecb_surveys/survey_of_professional_forecasters/html/index.en.html. See also Bowles et al. (2007).

[3] More precisely the survey switches from collecting "fixed-horizon" expectations to "fixed-event" expectations.

Figure 1 – median (8-quarter ahead) inflation forecast and main APP announcements

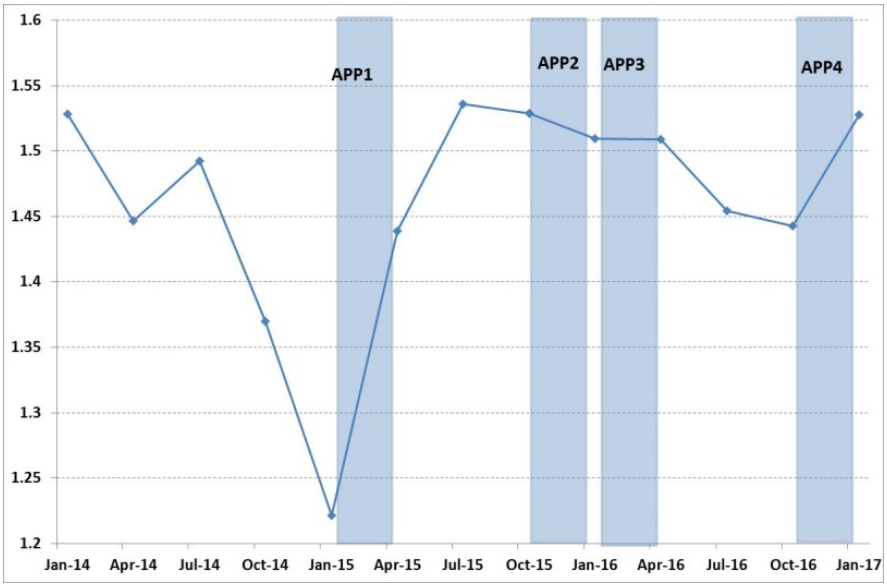


Figure 2 – median (8-quarter ahead) inflation probability distribution and main APP announcements

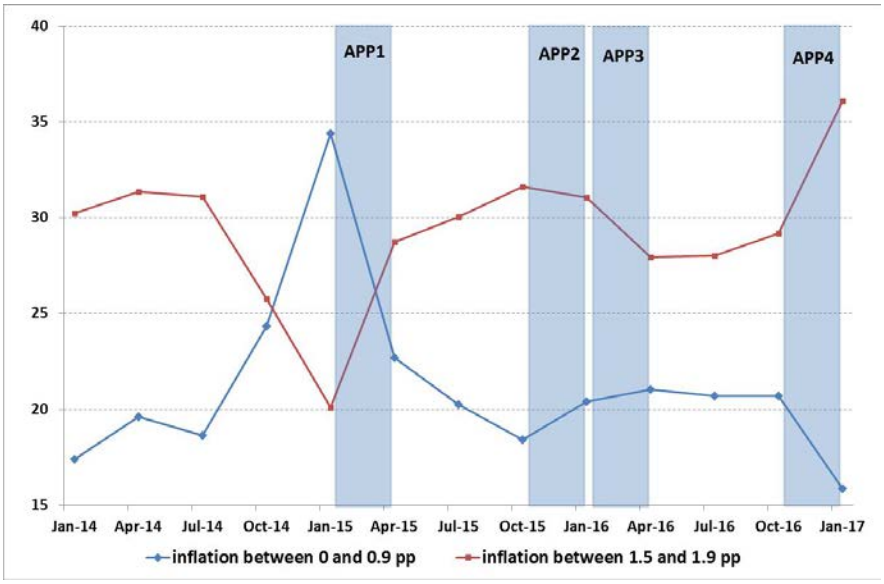
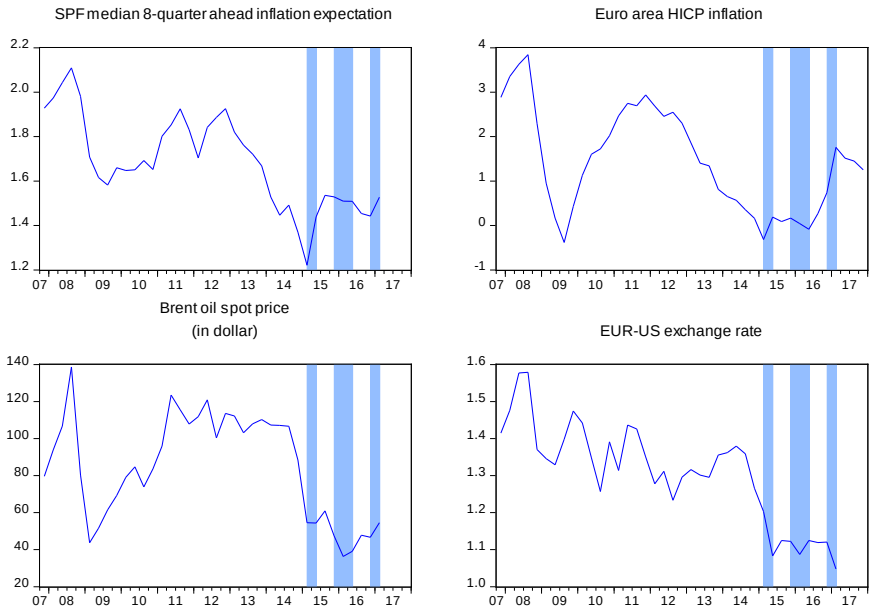


Figure 3 – SPF inflation expectations and macroeconomic drivers



With the following regression we try to answer the question: how much of the observed revisions in point- and probability forecasts of inflation is due to ECB APP related policy announcements?

$$\mathrm{REV}_t^{t+8} = c + \sum_{n=1}^{4} \gamma_{n_1} \cdot \mathrm{APP}_{it} + \beta_2 \cdot \mathrm{HICP}_t + \beta_3 \cdot \Delta U_t + \beta_4 \cdot \Delta \mathrm{OIL}_t + \beta_5 \cdot \Delta \mathrm{EUR}_t + \beta_5 \cdot \Delta i_t + \varepsilon_t \quad \text{(eq. 1)}$$

where $\mathrm{REV}^{t+8}{}_t$ is either the revision (between round t and round t-1) of the median forecast for inflation ($\mathrm{E}_t\pi^{t+8} - \mathrm{E}_{t-1}\pi^{t+8} \equiv \mathrm{REV}_t^{t+8}$) or the revision of the median probability assigned to the event that inflation will be between 0.0 and 0.9 percent ($\mathrm{E}_t\mathrm{Prob}(0 < \pi^{t+8} < 0.9) - \mathrm{E}_{t-1}\mathrm{Prob}(0 < \pi^{t+8} < 0.9) \equiv \mathrm{REV}_t^{t+8}$). On the right-hand side we include four dummy variables (APP_{nt}) taking value of 1 in the SPF round immediately following the corresponding policy event (as defined previously). Furthermore we add a set of controls: HICP_t is the cumulated "surprise" (defined as difference between official release and market expectations) in the HICP inflation releases published in the months between SPF rounds and captures changes in the initial conditions, U_t is the latest euro area unemployment figure available to survey respondent during each survey round (usually that referring to the second month of previous quarter) and proxies for domestic price pressures related to the labour market. OIL_t is the average dollar spot price of Brent oil contracts, calculated during the 15 days prior to the end of each SPF round and EUR_t is similarly calculated as the average value of the bilateral EUR-USD exchange rate. Finally, I_t is the average value of the Eonia rate calculated over the same time window and is included to account for the stance of conventional monetary policy. Unlike daily event studies based on inflation swap contracts, we do not include the lagged value of the policy dummies as one may confidently assume that within a quarter all effects will unfold. Table 2 shows that the announcement of the APP launch on January 22nd 2015 led to a significant upward revisions in the median inflation forecast (1st column), quantified in 20 basis points. At the same time, the announcement modified the median probability distribution by reducing significantly, by 11 percentage points, the probability-mass associated with inflation falling below the ECB target (second column)[4]. On the contrary, subsequent modifications of

[4] The survey asks participants about the probability of inflation falling between pre-specified interval. In this analysis we chose to focus on the [0.0-0.9] percent bracket as a proxy for significant downward deviation of inflation from the ECB target.

the APP programme did not have a significant impact on average inflation expectations nor on the probability mass of inflation being extremely low (between 0.0 and 0.9 per cent).

Table 1: estimated effect of APP events on 8 quarter ahead SPF median expectation and median probability of inflation being between 0 and 0.9 pp

	$REV_t^{t+8} \equiv \Delta E_t \pi^{t+8}$	$REV_t^{t+8} \equiv \Delta Prob(0 < \pi^{t+8} < 0.9)$
C	-0.006 (0.007)	0.444 (0.291)
$HICP_t$	0.081* (0.038)	-2.536 (1.442)
ΔOIL_t	0.022*** (0.050)	-6.038*** (1.881)
ΔI_t	0.073** (0.031)	-1.469 (1.162)
ΔEUR_t	-0.161 (0.176)	6.947 (6.610)
ΔU_t	-0.001 (0.045)	0.619 (1.635)
APP_1	0.205*** (0.064)	-11.269*** (2.364)
APP_2	0.037 (0.061)	-0.351 (2.291)
APP_3	0.027 (0.062)	0.073 (2.246)
APP_4	0.061 (0.066)	-3.781 (2.372)
R^2	0.55	0.56
N. obs	60	60
Sample period	2002q2-2017q1	2002q2-2017q1

Note: Robust standard errors in parentheses. Significance levels: (*) 10% ;(**) 5% ;(***) 1%.

3 The effects of ECB APP on inflation expectations: panel results from the ECB SPF

In this section we exploit the cross-sectional dimension of the SPF dataset to investigate the relationship between the announcements of ECB asset purchases and inflation expectations, focusing on the January 22nd announcement as the only relevant one (APP_1). The use of micro-data allow us to safely assume that macroeconomic announcements are exogenous with respect to individuals expectations and therefore to rule out the possibility that our results are affected by reverse causality. Equation 1 then becomes:

$$\mathrm{REV}_{\mathrm{it}}^{\mathrm{t+8}} = \alpha_{\mathrm{i}} + \beta_1 \cdot \mathrm{APP}_{1\mathrm{t}} + \phi \mathrm{X}_{\mathrm{it}} + \delta \mathrm{M}_{\mathrm{t}} + \varepsilon_{\mathrm{it}} \qquad \text{(eq. 2)}$$

where the dependent variable has both a time and cross-sectional dimensions ($REV_{it}^{t+8} \equiv \mathrm{E}_{\mathrm{it}}\pi^{\mathrm{t+8}} - \mathrm{E}_{\mathrm{it-1}}\pi^{\mathrm{t+8}}$), α_{i} are individual fixed effects to control for unobserved heterogeneity and APP is the monetary policy announcement of the 22nd January 2015. In terms of controls, we pick variables from two sets of controls. The first set (X_i) includes individual specific variables obtained from the SPF survey and generally refer to survey participants expectations about variables of interest for inflation forecasting. These include expectations on the main policy rate ($E_{it}\{I_{t+1}\}$) to control for the effects of conventional monetary policy, individual short-term expectations on oil prices ($E_{it}\{OIL_{t+1}\}$) and the bilateral euro-US dollar exchange rate ($E_{it}\{EUR_{t+1}\}$) as important driver of inflation dynamics but also individual past forecast errors (π_{it}^{err}); the latter account for revisions the forecaster may choose to do on the basis of his latest forecast error. The second set of controls includes macroeconomic and financial variables common to all forecasters such as the level of the unemployment rate (U_t), the cumulated "surprise" in the HICP inflation releases published in the months between SPF rounds ($HICP_t$), the level of stock market volatility recorded in the days prior to each survey round (V_t). These variables act as time fixed effects common across forecasters.

Table 2 reports the main results. In column 1 the controls are all individual specific. In particular we have included forecaster past error and short term expectations on oil prices, short term interest rate and the bilateral EUR-US exchange rate. The estimation results suggest that the APP announcement led to a sizeable (18 basis points) and statistically significant upward revision of individual inflation expectation, in line with the aggregate evidence. As for the control variables, the individual past forecast error and the short term expectation on the policy rate have a significant and positive impact on forecast revisions. On the contrary, individual short-term expectations on oil prices and on the bilateral exchange rate have no significant effect. In column 2, we substitute the latter two individual specific controls with their respective market variables. Furthermore we also include the VSTOXX index of stock market volatility (V_t) in order to account for the effects of financial stress on inflation expectations and the unemployment rate (U_t) to account for labour market pressure on domestic prices. In this specification, the effect of the APP is quantitatively confirmed and statistically more significant. Oil prices have a significant impact on inflation expectations while coefficients on the financial stress indicator, on the bilateral exchange rate and on the unemployment rate are not significant[5]. In column 3, we further include in the set of common controls, the cumulated inflation surprise ($HICP_t$) and we drop the unemployment rate and the bilateral exchange rate. The impact of the APP announcement remains significant and equal to 19 basis points. The effect of median HICP surprise is positive and significant notwithstanding the presence of individual past error among the regressors.

[5] We have obtained similar results using the nominal effective exchange rate.

Table 2: effect of APP introduction on individual point forecasts

	REV_{it}^{t+8}		
	Column 1	Column 2	Column 3
π_{it}^{err}	0.015*** (0.006)	0.017*** (0.005)	0.011* (0.006)
$\Delta E_{it}\{OIL_{t+1}\}$	0.039		
$\Delta E_{it}\{I_{t+1}\}$	0.105*** (0.024)	0.058** (0.031)	0.058** (0.023)
$\Delta E_{it}\{EUR_{t+1}\}$	0.112 (0.15)		
APP_1	0.180** (0.071)	0.20*** (0.058)	0.19*** (0.058)
ΔU_t		-0.04 (0.031)	
$HICP_t$			0.060* (0.034)
ΔOIL_t		0.113** (0.048)	0.11** (0.049)
ΔEUR_t		0.064 (0.058)	
ΔV_t		-0.0005 (0.021)	
R^2	0.048		0.05
N. obs	1229	1436	1436

Note: Robust standard errors in parentheses. Significance levels: (*) 10% ;(**) 5% ;(***) 1%.

In Table 3 we repeat the analysis and we focus on individual probability distributions. Specifically we focus on the [0-0.9] bracket to proxy for individual perception of inflation remaining too low. We find that the APP announcement led to a significant reduction (by 8 percentage points) in the probability of inflation being significantly below target in two years.

Table 3: effect of APP introduction on individual probability of low inflation

	$\Delta \mathbf{Prob_{it}}(\mathbf{0} < \boldsymbol{\pi}^{\mathbf{t+8}} < \mathbf{0.9})$
π_{it}^{err}	-0.153 (0.227)
$\Delta E_{it}\{I_{t+1}\}$	-2.16*** (0.628)
APP_1	-8.47** (3.96)
$HICP_t$	-1.85* (0.939)
ΔOIL_t	-4.262** (1.945)
R^2	0.059
N. obs	1315

Note: Robust standard errors in parentheses. Significance levels: (*) 10% ;(**) 5% ;(***) 1%.

Finally, Table 4 reports a sensitivity check whereby, using the same regression equation as in Table 3, we quantify the effect of the APP announcement on the whole probability distribution. In line with previous results, we find that the introduction of the APP led to a significant shift of individual probability mass to the right. The most affected sections of the distribution are the [0.5-0.9] per cent bracket (negatively) and the [1.5-1.9] bracket (positively), with only minor changes in the most extreme brackets, indicating that the ECB was successful in re-anchoring inflation expectations without losing its price stability commitment.

Table 4: effects of APP introduction on individual probability brackets

	Effect on probability of:
$-0.5 < \pi^{t+8} < 0.4$	**-4.84****
$0.0 < \pi^{t+8} < 0.9$	**-8.47****
$0.0 < \pi^{t+8} < 0.4$	*-3.4**
$0.5 < \pi^{t+8} < 0.9$	*-4.99***
$1.0 < \pi^{t+8} < 2.4$	**9.38****
$1.0 < \pi^{t+8} < 1.4$	*-0.55*
$1.5 < \pi^{t+8} < 1.9$	*6.72***
$2.0 < \pi^{t+8} < 2.4$	*3.21***
$2.5 < \pi^{t+8} < 2.9$	0.567
$-0.5 < \pi^{t+8} < 0.4$	-4.845*

Note: Robust standard errors in parentheses. Significance levels: (*) 10% ;(**) 5% ;(***) 1%.

The analysis so far has been conducted on the unbalanced panel. In this context, the results might be driven by entry and exit from the dataset around the date of interest. In particular, as an extreme example, suppose that the model is estimated on a fixed group of forecasters up to 2015q1 and that in 2015q2 a second group of forecasters with on average higher inflation expectations than the first one enters the panel. In this set-up the model would not be able to "explain" the increase in inflation expectations and would therefore attribute to the APP dummy variable all the unexplained increase. Differences in the structural characteristics between the forecasters surveyed in 2015q2 and those surveyed over the remaining periods (perhaps due to entry and exit from the survey) may indeed lead to biased estimates of the effects of the APP announcement. In order to control for such compositional effects, we re-ran the main regressions (the one in table 2 column 3 and that of Table 3) focusing only on those forecasters that are present both in the January and April 2015 rounds of the SPF survey (so that revisions of expectations can be computed), while forecasters that are present in other rounds but are missing in those two rounds are dropped from the analysis. Table 5 reports the results (based on around 890 observations, down from 1436 in the benchmark regression) and shows that the main results are basically unchanged; specifically while the coefficients on HICP and π_{it}^{err} are less significant, the coefficient on the APP_1 dummy variable is almost unchanged compared to the main estimate.

Table 5: robustness to compositional effects

	REV_{it}^{t+8}	$\Delta \mathbf{Prob_{it}}(\mathbf{0} < \boldsymbol{\pi}^{\mathbf{t+8}} < \mathbf{0.9})$
π_{it}^{err}	0.006 (0.006)	-0.012 (0.251)
Δ $E_{it}\{I_{t+1}\}$	0.069 (0.032)**	-2.402** (0.917)
APP_1	0.18*** (0.0597)	-8.433** (4.214)
$HICP_t$	0.080** (0.038)	-2.817*** (0.954)
ΔOIL_t	0.0787 (0.054)	-4.462*** (2.361)
R^2	0.05	0.071
N. obs	889	882

Note: Robust standard errors in parentheses. Significance levels: (*) 10% ;(**) 5% ;(***) 1%.

3.1 Heterogeneity across forecasters

So far we have estimated the average effect of the APP on forecasters inflation expectations. In this section we document some interesting differences across forecasters that may shed some light on which forecasters are most affected by policy announcements[6]. One dimension we can analyze is forecasters' accuracy. Accuracy can be measured based on different economic variables and forecast horizons. Here for each forecaster we calculate his Root Mean Squared Forecast Errors (RMSFE) based on 2-year ahead forecasts. We then divide the sample into "accurate" forecasters, with RMSFE values less than or equal to the average, and "inaccurate" forecasters, with RMSFE values above the average[7] and re-run the regressions for the two subgroups. Interestingly, we find that the estimated effect of the APP announcement on point forecast for the subgroup of accurate forecasters increases to around 30 basis points and is highly significant, while the effect estimated for the inaccurate subgroup slightly decreases and is far less significant (Table 6). Also looking at probability distributions, the effect on the accurate forecasters is very precisely estimated around 7 percentage points, while the effect on inaccurate forecasters probability distribution is considerably less precisely estimated. Overall, these results have implications for models of inflation expectations and of the transmission of monetary policy, as they suggest that representative agent models might fail to capture some relevant aspects of the interaction between agents beliefs, information dispersion and monetary policy communication.

Table 6: heterogeneous effects

Accurate forecasters	**Inaccurate forecasters**
Effect of ECB announcement on $\Delta \mathbf{E_{it}}\boldsymbol{\pi}^{\mathbf{t+8}}$	
0.34*** (0.01)	0.16* (0.06)
Effect of ECB announcement on $\Delta \mathbf{Prob_{it}}(\mathbf{0} < \boldsymbol{\pi}^{\mathbf{t+8}} < \mathbf{0.9})$	
-6.7*** (0.42)	-9.3* (4.73)

Note: Robust standard errors in parentheses. Significance levels: (*) 10% ;(**) 5% ;(***) 1%.

[6] Considering the limited information on forecasters characteristics, the range of issues that can be explored is limited.
[7] We take the average across forecasters in 2015Q1 as threshold value.

4 Conclusions

In this paper we study the effects of Eurosystem's expanded Asset Purchase Programme (APP) on inflation expectations. Exploiting the information provided by the ECB survey of professional forecasters we find that the launch of the APP on the 22nd of January 2015 succeeded in increasing inflation expectations. In particular, we find that the announcement led to an upward revisions in 2-year ahead inflation forecasts by 20 basis points (on average across SPF respondents), a value in line with high frequency event study of market (inflation swap price) based inflation expectations (see for instance Altavilla et al. (2015 and Bulligan and Delle Monache (2018)). We also find that the announcement shifted the individual probability distributions to the right: more precisely it led to a reduction by around 10 percentage points of the probability associated with inflation falling between 0.0 and 0.9 per cent 2-year ahead and with an equivalent increase in the probability of inflation falling between 1.0 and 2.4 per cent. Furthermore the average effect masks significant differences across forecasters. In particular we find that forecasters that had been more accurate (than average), prior to the policy announcement revised their inflation forecasts more strongly than less accurate forecasters. Our results support therefore the existence of an active expectation channel. However our results suggest also that subsequent APP related announcements did not lead to a reassessment of price developments in the medium-term. This could be due to the inadequacy of event study regressions to properly account for pre-announcement expectations. Indeed, while the launch of the APP represented a change in paradigm in the conduct of monetary policy, by the time subsequent recalibrations occurred market participants had adjusted to the new environment and had sufficient information to guess the "new" policy reaction function.

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