BANCO DE **ESPAÑA**

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INFLATION PERSISTENCE IN THE EURO AREA: THE ROLE OF EXPECTATIONS

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ABSTRACT

This article analyses agents' perception of the period of low inflation in recent years, in the context of a model in which these agents form their expectations on the basis of simple forecasting rules. The approach used allows a distinction to be drawn between which portion of the low inflation phenomenon might be due to temporary factors and which might be considered permanent. The results of the analysis for the euro area suggest that agents perceive the inflation rate's recent departure from the monetary policy objective to be predominantly temporary, although these deviations are marked by a considerable degree of persistence. In comparative terms, the estimated persistence in the case of the euro area of the deviations observed from the inflation target approximately double those in the United States over the 1-and 5-year horizons.

Keywords: expectations, inflation, learning.

JEL classification: C53, D84, E30, E44.

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Introduction

Most of the central banks of the advanced economies have received the institutional mandate to maintain price stability, defined by a medium-term inflation target. Specifically, in the case of the ECB, the mandate refers to keeping inflation rates *close to, but below, 2% in the medium term.*

This objective is defined in terms of the Harmonised Index of Consumer Prices (HICP), whose basket includes both the components that comprise the core indicator (i.e. services and non-energy industrial goods) and energy and food. As a proxy for the overall indicator, in the model presented in this article the analysis of inflation in the medium term focuses on the core indicator. This has the disadvantage that the monetary policy objective is not strictly represented, but it does provide more readily for the study of the role of expectations in the persistence of the inflationary phenomenon, given that the trend of the core indicator is comparatively less volatile.

The rates of the overall and core indicators are depicted in Chart 1. As Chart 1.2 shows, the core inflation rate hovered between 1.5% and 2% on average from the time the euro came into being to the start of the global financial crisis. However, since then, and particularly since 2014, the euro area core inflation rate has stood for a prolonged period below its previous figures. For the 2009-2019 period, the rate of change of core inflation was 1.1%, 0.6 pp down on the phase prior to the global financial crisis. And further to the outbreak of COVID-19, this disinflationary process has tended to become more acute. Such a prolonged period of moderate inflation might be due either to temporary causes, albeit with high persistence, or, alternatively, to more structural reasons.

The first group of explanatory factors, namely the temporary ones, would include elements such as the decline in energy prices or the durable presence over this period of a high degree of slack both in the euro area and global economies. The structural causes influencing long-term inflation movements relate to changes in certain fundamentals of the economy. These include most notably sectoral composition (with an increase in the weight of the services sector[1]), globalisation

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1 In particular, there is a growing body of evidence indicating that services prices are adjusting with less frequency than in other sectors of the economy. See, for example, Bouakez, Cardia and Ruge-Murcia (2014), and Álvarez et al. (2006).
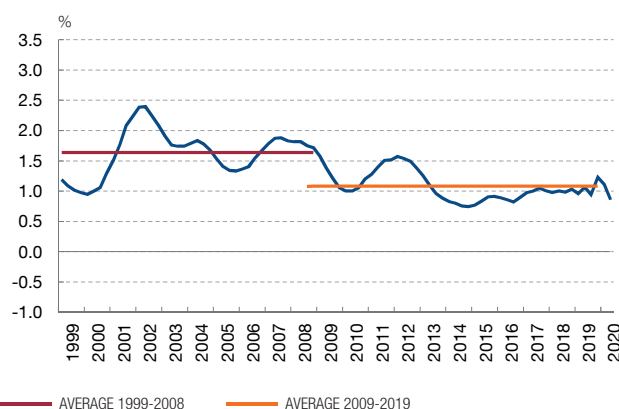
Chart 1
EURO AREA INFLATION

Over the past six years, the euro area core inflation rate has stood for a prolonged period below the ECB objective.

1 INFLATION IN THE EURO AREA

2 CORE INFLATION IN THE EURO AREA

YEAR-ON-YEAR RATE (QUARTERLY FREQUENCY) —— AVERAGE 1999-2008 —— AVERAGE 2009-2019
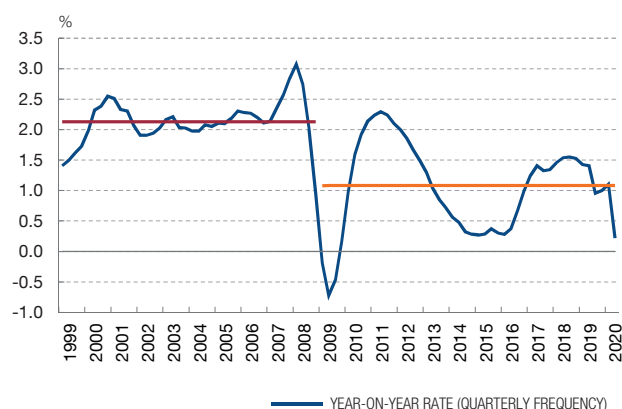
SOURCE: Eurostat.

(which would give rise to a greater interconnectedness of inflation rates across different economies, against the backdrop of the progressive incorporation into global trade of countries with lower production costs) and changes in consumption patterns linked to population ageing.[2]

A path of inflation expectations that are stable and consistent with the price stability objective smooths monetary policy implementation, leading generally to a reduction in the volatility of the economic cycle. However, the prolongation over time of the current low-inflation phase has given rise to a debate on some deanchoring of inflation expectations in relation to the central bank's medium-term objective, and potential feedback between actual inflation and expectations.[3] As a result, the diminished pace of prices would be exerting a downward impact on economic agents' inflation expectations, which would in turn affect, in the same direction, actual inflation.

This article proposes an explicit modelling of economic agents' inflation expectations formation process. That would allow us to determine to what extent agents perceive the current inflation rate deviations as temporary or permanent. The following section of the article evidences the significance of the expectations formation process in the monetary policy realm, using a macroeconometric model estimated for the euro

2 For a more detailed discussion on possible temporary and structural factors, see Chapter 2 of the Annual Report 2018, Banco de España (2019).

3 See Cœuré (2019).

area. Subsequently, the final section shows the expectations estimated by this model at different horizons, offering evidence on agents' perception of the temporary or permanent nature of inflation deviations from target.

The importance of the formation of expectations for inflation dynamics

Most models traditionally used in monetary policy design start from the premise that agents form expectations about the economy rationally.[4] This hypothesis implies that, in the shaping of their expectations, agents observe and process efficiently all available information. In particular, agents are able to understand the nature of macroeconomic shocks and their duration, and have the capacity to consistently incorporate news on monetary policy changes or on expected developments in the economy into their expectations. However, in reality, it is unlikely that agents are able to observe and process all available information.[5] On numerous occasions, then, the nature of shocks, or their transmission channels, are only imperfectly known by agents and are difficult to identify. Consider, as an obvious example, how difficult it would be for any agent to estimate the intensity and duration of the current health crisis.

An alternative hypothesis involves assuming that expectations are adaptive in nature.[6] In this case it is assumed that agents' expectations about future events are partly and progressively updated with the information they receive about developments in the main macroeconomic aggregates. It is further assumed that, when shaping their expectations, agents use a limited amount of information that includes interest rates and the inflation rate (such that their expectations are changed when faced, for example, with an announcement by the central bank about the level of interest rates or a new price growth figure).

The model used in the analysis in this article is similar to the general equilibrium model of Smets and Wouters (2007). It is a stylised representation of the structure of the euro area economy in which agents adopt their decisions optimally. Given a shock, the model also allows its macroeconomic impact and its related channels of transmission to be analysed. These characteristics have meant that the use of this family of models in the central banking field has become widespread.

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4   For instance, some of the general equilibrium models habitually used by the Federal Reserve of New York (FRBNY DSGE) or the ECB (EAGLE), mainly to conduct simulation exercises, are based on rational expectations.

5   The economic literature has proposed alternatives to the rational expectations hypothesis, such as the possibility that agents may not pay sufficient attention to economic news (inattentive agents), that they may not have sufficient information about the news (imperfect information) or that they are not capable of fully incorporating this information into their expectations (imperfect rationality). See the discussion in this connection in Aguilar and Vázquez (2018).

6   See the seminal paper by Marcet and Sargent (1989) and subsequent developments, such as the work by Eusepi and Preston (2011) and Slobodyan and Wouters (2012).

In the variant used in this article, the hypothesis of rational expectations has been replaced by that of adaptive expectations.[7] The model, estimated for the euro area as a whole for the period from 1991 Q1 to 2019 Q4, combines information from macroeconomic variables (consumption and inflation, among others) with financial information relating to the yield curve.[8] The inclusion of the yield curve enables financial-market information on the future course of the economy to be incorporated.[9] Accordingly, this specification allows a fuller characterisation of expectations, by combining macroeconomic and financial information.

More specifically, the expectations-formation mechanism in respect of consumption, investment and inflation in the model rests, in each period, on simple learning rules that take into consideration the latest observed figure and the errors committed in the past. In the specific case of inflation, the rule for updating expectations is as follows:

$$E_t\pi_{t+i} = \alpha_{i,t-1} + \beta_{\pi_i,t-1}\pi_{t-1}$$

where π_{t-1} is the deviation from target observed in the last quarter and $\beta_{\pi_i,t-1}$ measures the degree of transmission of the observed deviation to expectations i (denoting a number) quarters ahead. That is to say, under this rule agents incorporate the latest available information on the deviation by inflation from target into their inflation expectations at different horizons (up to 5 years). Moreover, this learning rule allows for the capture through $\alpha_{i,t-1}$ of the possibility that deviations from the inflation objective may have a permanent impact on expectations about the behaviour of this variable over a horizon of i quarters ahead. Three possible values are considered in the analysis for i: one, four or 20 quarters.

The greater the persistence of the deviations perceived by agents (π_{t-1}) is, for a given horizon i, the greater $\beta_{\pi_i,t-1}$ will be and, therefore, the higher the pass-through of these deviations to expectations. By way of illustration, a value of β_{π_i} equal to 0.5, means that agents expect the latest observed deviation from target to halve one quarter ahead. Alternatively, a unit value for this coefficient would mean that agents expect the deviation to hold in full in the following quarter. Further, if agents were to believe that deviations from target are permanent, which would be tantamount to a change in the inflation objective, then the coefficient $\alpha_{i,t-1}$ would be observed to be other than zero.

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7 The model used is based on the general equilibrium model of Smets and Wouters (2007), in which the hypothesis of adaptive expectations about inflation is extended to longer horizons (up to 10 years), as in Aguilar and Vázquez (2018).

8 Specifically, use has been made of the quarterly series of the core inflation rate (measured by the HICP of services and non-energy industrial goods), the policy interest rate set by the ECB, hours worked, real private consumption, real investment, compensation per employee and real GDP, along with nominal yields on benchmark euro area sovereign bonds at horizons of 1, 3 and 5 years, which allows expectations at different terms to be estimated.

9 In particular, the breakdown of nominal interest rates into the real, risk-free interest rate, inflation expectations and a risk component enables the relationship between the implied yield on a bond and the inflation rate to be exploited.

Under this simple expectations-formation framework, it is possible to estimate both coefficients and, on the basis thereof, to analyse the degree of temporariness of the deviations from inflation assigned by agents on constructing their expectations. Under a scenario of fully credible monetary policy, agents would not perceive permanent deviations from target ($\alpha_i = 0$) and temporary deviations would diminish over the course of the horizon ($\beta_{\pi_1} > \beta_{\pi_4} > \beta_{\pi_{20}}$).

The path of expectations and of their components

Chart 2 shows, for the different horizons analysed, the estimated coefficients for the euro area. As might be expected, the value of the coefficients indicates that, excepting the odd isolated period, the weight assigned by agents to past inflation in their formation of expectations about price growth diminishes as the time horizon increases ($\beta_{\pi_1} > \beta_{\pi_4} > \beta_{\pi_{20}}$). The value of the coefficient at one quarter (β_{π_1}) is close to unity, suggesting that agents expect, at three months, that the deviations of inflation from target will hold unchanged. Moreover, this coefficient has been highly stable since the start of Economic and Monetary Union. In the case of medium-term expectations, i.e. four and 20 months ahead (β_{π_4} and $\beta_{\pi_{20}}$), the estimates suggest that agents reduce, as the time horizon increases, the weight they assign in their learning rule to the latest observed figure. The course of both coefficients shows a positive correlation with the behaviour of actual inflation, indicating that, in periods with higher price growth (2001-2002 and 2007-2008), agents estimate that deviations have a higher persistence. That suggests the prices show a different degree of adjustment according to the level of the inflation rate.[10] In any event, according to the model, in the longer run inflation would return, in the absence of fresh shocks, to the medium-term monetary policy objective, since the value estimated for $\alpha_{i,t-1}$ is very close to zero.[11]

On estimating the same model for the United States, the degree of persistence of inflation over the past 20 years on average can be seen to be less in this country than in the euro area. That might be indicative of fewer rigidities (see Chart 2.2).

A shock to inflation will be more or less persistent depending on a series of factors which include, among others, the degree of wage inertia (depending on the degree to which wages are linked to the overall price index), price-setting rigidities and supply-side rigidities (which, in the model, are manifest via a limited capacity to adjust the use of productive factors).

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10 One possible explanation is the greater ease with which firms can, in periods of excess demand, raise prices instead of increasing productive capacity. Conversely, in periods of low demand, they can opt to reduce their capacity temporarily. See Bobeica and Sokol (2019).
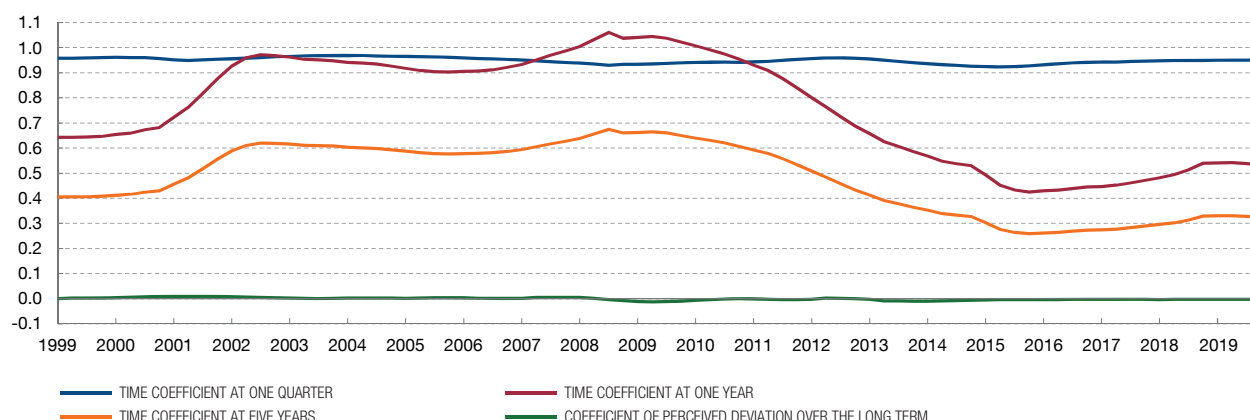
11 The chart depicts the coefficient estimated when i = 20 quarters. In practice, the estimated value when i is equal to 1 or 4 is very similar, which can be explained by the fact that agents have the same information to estimate the long-term deviation by inflation from target irrespective of the horizon i at which they formulate their short or medium-term expectations.
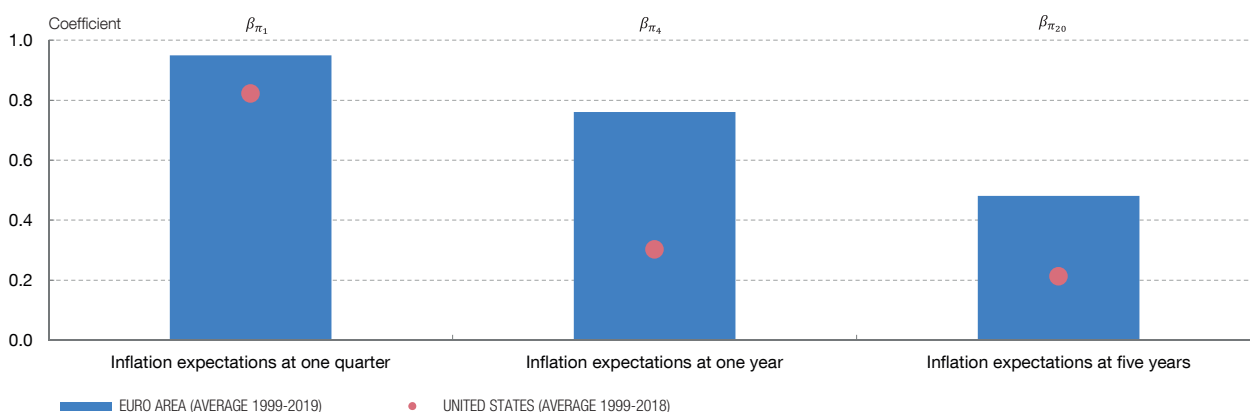
Chart 2
INFLATION EXPECTATIONS

Agents perceive inflation rate deviations from target as temporary, although they are potentially persistent.

1 COEFFICIENTS OF INFLATION

— TIME COEFFICIENT AT ONE QUARTER
— TIME COEFFICIENT AT ONE YEAR
— TIME COEFFICIENT AT FIVE YEARS
— COEFFICIENT OF PERCEIVED DEVIATION OVER THE LONG TERM

2 SENSITIVITY OF INFLATION EXPECTATIONS TO RECENT INFLATION

■ EURO AREA (AVERAGE 1999-2019)   ● UNITED STATES (AVERAGE 1999-2018)

SOURCES: Area Wide Model Database and Federal Reserve Bank of St. Louis.
NOTE: Calculations made using the model of Aguilar and Vázquez (2018). Although the model estimates the perceived deviation in the different inflation-expectations horizons over the long term, this coefficient is the same for the three horizons presented.

In the case of the model estimate of the United States, the degree of wage indexation is comparatively lower, while the flexibility of prices is greater.[12] Consequently, inflation expectations in the US economy are less sensitive to past inflation, mainly in the medium and long term. Specifically, the coefficients estimated for β_{π_4} and $\beta_{\pi_{20}}$ (i.e. 1 and 5 years ahead) are approximately half those obtained for the euro area, meaning that the deviation by expectations in the face of a shock is less both in terms of level and duration.

The results shown in this article depend on the model used. One means of validating the estimates offered is by comparing the inflation expectations at one year obtained
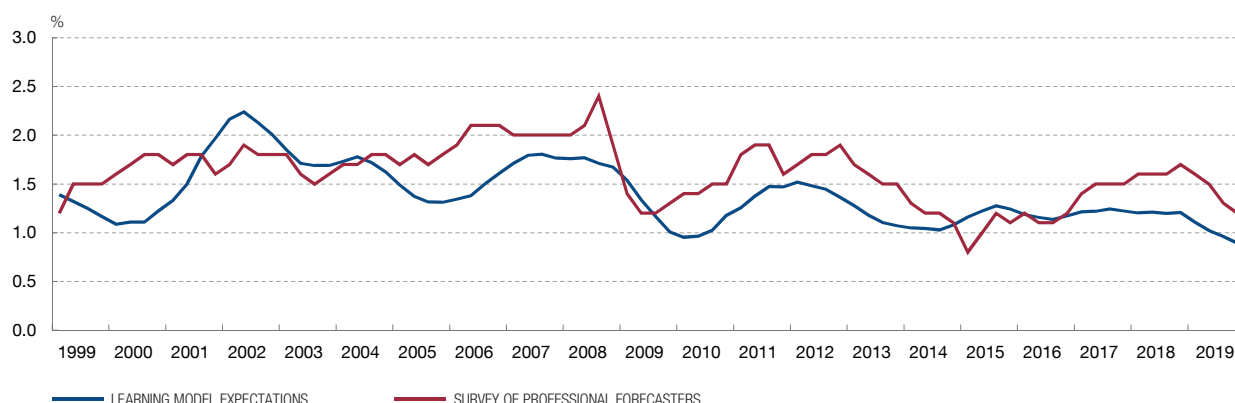
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12   See the results of the model for the United States in Aguilar and Vázquez (2018).

Chart 3

INFLATION IN THE EURO AREA

The dynamics captured in the model are consistent with the ECB Survey of Professional Forecasters for the euro area.

INFLATION EXPECTATIONS AT ONE YEAR SERIES: MODEL vs SPF

LEARNING MODEL EXPECTATIONS — SURVEY OF PROFESSIONAL FORECASTERS

SOURCES: ECB and own calculations.

with the model that takes those drawn from the ECB's Survey of Professional Forecasters (SPF). This quarterly survey reflects the expectations of participant respondents – who are experts from financial and non-financial institutions alike in the euro area – about inflation rates, GDP growth and euro area unemployment at different horizons.[13] The comparison between both sources shows how the dynamics captured in the model are consistent with the SPF series (see Chart 3), which validates the results obtained.

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13   The definition of the inflation rate series about which the survey's expectations are formulated is the overall HICP, which includes food and energy goods prices, unlike the core HICP used in the exercise conducted in this article. That would explain why the oscillations in inflation expectations are comparatively somewhat greater when they are measured according to the survey.

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