



BANCA D'ITALIA  
EUROSISTEMA

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(Occasional Papers)

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indicators, analyses and models used at Banca d'Italia

by Sara Cecchetti, Davide Fantino, Alessandro Notarpietro, Marianna Riggi,  
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# INFLATION EXPECTATIONS IN THE EURO AREA: INDICATORS, ANALYSES AND MODELS USED AT BANCA D'ITALIA

by Sara Cecchetti\*, Davide Fantino\*, Alessandro Notarpietro\*, Marianna Riggi\*,  
Alex Tagliabracci\*, Andrea Tiseno\* and Roberta Zizza\*

## Abstract

This paper illustrates the tools used at Banca d'Italia (Bd'I) to monitor the evolution of inflation expectations. The paper also surveys the analyses conducted at Bd'I to assess how inflation expectations affect agents' choices and the economy. The first part discusses the measures of inflation expectations derived from the prices of inflation-linked financial instruments and from surveys of professional forecasters. The second part focuses on the measures of households' and firms' inflation expectations collected by Bd'I, along with analyses presenting empirical evidence that expectations do indeed drive agents' economic choices. The last part analyses the overall effect of exogenous changes in inflation expectations on the real economy through the lens of the macroeconomic models used at Bd'I.

**JEL Classification:** E31, E32

**Keywords:** Inflation expectations, anchoring, surveys

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## 1. Introduction and main results

Inflation expectations are of foremost importance for the conduct of monetary policy. The European Central Bank's (ECB) mandate is to achieve price stability, defined as an annual inflation rate "below, but close to, 2% over the medium term". To help achieve that goal, the ECB strives to "anchor" medium-term inflation expectations around that level. If consumers and businesses expect that the ECB will achieve the inflation target, they will plan price and wage increases accordingly. Thus, anchoring inflation expectations helps the ECB to achieve its target.

Moreover, inflation expectations matter for the short-run stabilization policy of the ECB as they affect current and future expected real interest rates. The term structure of real rates is what ultimately determines the transmission of monetary policy, as it affects households' consumption and investment behaviour as well as firms' wage and pricing decisions. The ECB sets interest rates – and other non-standard monetary policy measures – in such a way that real rates are above (below) the "natural interest rate" – a frictionless medium-term equilibrium rate – when the economy is booming and above its potential (is in a recession and below its potential).

For the reasons outlined above, it is crucial for the ECB to monitor the evolution of inflation expectations accurately. There are three types of indicators suited for the purpose: market prices of inflation-related financial instruments, surveys of professional forecasters, and surveys of consumers and businesses. This paper surveys how these tools are used at Banca d'Italia (Bd'I) and illustrates the analyses that assess how inflation expectations affect agents' choices and the real economy. The first part discusses measures of inflation expectations derived from the market prices of inflation-linked financial instruments (Sections 2 and 3) and from surveys of professional forecasters (Section 4). It argues that both categories of indicators point to possible de-anchoring from the ECB's inflation aim. The second part surveys the measures of the inflation expectations of individual households and firms, collected by Bd'I (Section 5), along with analyses presenting empirical evidence that expectations do indeed drive agents' economic choices (Section 6). The last part analyses the overall effect of exogenous changes of inflation expectations on the real economy through the lens of the macroeconomic models used at Bd'I (Section 7).

Since the end of the sovereign debt crisis, both the actual and expected euro-area inflation rates have been drifting downwards, reaching very low levels; a further reduction occurred after the outbreak of the COVID-19 pandemic. The declining trend, which has raised concerns about a possible de-anchoring of inflation expectations from the ECB's inflation aim, is evident from both market-based indicators as well as from surveys of professional forecasters. Market-based indicators of long-term inflation expectations have been showing clear signs of de-anchoring. Even though their dynamics are partly driven by the inflation risk premium, analyses conducted by Bd'I staff estimate a sizeable role of the expectation component. Thus, market-based indications of rapidly deteriorating expectations can be considered as genuine signals. Inflation options – caps and floors – provide further evidence of de-anchoring, which is embedded in the implied risk-neutral distribution of future inflation. The estimated

risk-neutral probability of inflation falling below 1% on average over the next five years has increased significantly since 2019, in particular during the peak of the pandemic in the spring of 2020. Measures of long-term inflation expectations obtained from surveys of professional forecasters have also shown signs of de-anchoring. Their values have never returned to the levels that had prevailed before 2013-14. Moreover, they have become more sensitive to short-term expectations and to negative inflation surprises.

A central premise of dynamic economic theory is that agents' behaviour depends crucially on their individual inflation expectations. These are measurable, with well-designed hypothetical survey questions, and Bd'I has a tradition of collecting them. The Survey of Household Income and Wealth (SHIW) has gathered, in some waves, data on households' expectations along with detailed demographic and financial information. The Survey on Inflation and Growth Expectations (SIGE) regularly collects information on firms' expectations along with pricing intentions and other business information. While in the literature there is evidence that, on average, households' expectations exceed those of firms, those of professional forecasters and realized inflation, analyses based on SHIW data confirm that well-designed hypothetical survey questions tend to elicit unbiased expectations. The evidence also suggests that expectations are affected by households' inflation experience and respond quickly to news about current inflation. Empirical studies based on the SIGE provide evidence that firms' expectations are measured accurately and meaningfully and that they are influenced by the monetary policy stance and by news about current inflation, among other factors.

Households' inflation expectations determine consumption, via both intertemporal substitution and income effects. Even though this is undisputed, the empirical evidence on the direction of the net effect is mixed. A study by Bd'I staff suggests that two different regimes have characterized the Italian economy: during the recent low inflation period, households with higher inflation expectations have reported a lower readiness to purchase durables compared with other households, as the income effect has prevailed. On the contrary, during the high inflation period of the early 1990s, full wage-indexation neutralized the income effect, only substitution mattered, and households with higher inflation expectations brought forward expenditure more than other households. Firms' inflation expectations in turn determine their pricing, investment and employment decisions. A study by Bd'I staff and other co-authors shows that while in normal times Italian firms interpreted inflation news as supply-side driven, after policy rates reached the effective lower bound (ELB) they have tended to perceive a stronger demand-side channel. This is consistent with the behaviour of New Keynesian models when the policy rate is at its ELB. Other analyses carried out at Bd'I using a different approach have reached conclusions that are only partly similar.

Inflation expectations play an important role in macroeconomic models by affecting consumption and investment decisions on the demand side – via the real interest rate – by guiding wage and price formation on the supply side, and by influencing the exchange rate and asset prices. Simulations, conducted using the Quarterly Econometric Model and a medium-scale closed-economy Dynamic Stochastic General Equilibrium Model show that a temporary 50 bp shock to inflation expectations induces a peak increase of real GDP in a range of between 0.1 and 0.3 p.p. and a gradual rise in consumer

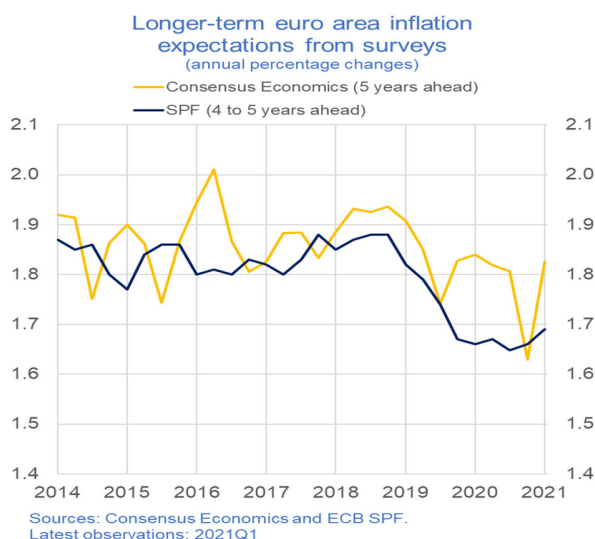


prices of nearly 0.50 p.p. In the first year, the effect on the GDP growth rate is between 0.08 and 0.12 p.p., that on inflation between 0.22 and 0.44 p.p.

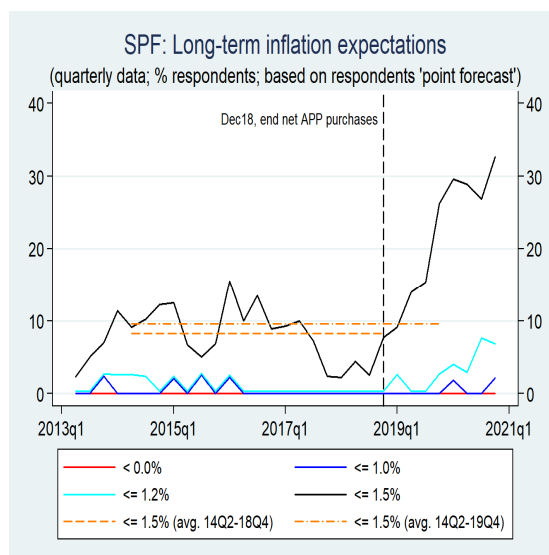
## 2. Market-based indicators of long-term inflation expectations

The downward trend of euro area inflation expectations, started with the sovereign debt crisis, has continued deteriorating in the following years according to all available surveys: the ECB’s Survey of Professional Forecasters (SPF), that of Consensus Economics and that of Eurozone Barometer all show the same indication (Figure 1). According to the latter, the recent drop has even been particularly large. Furthermore, since end-2018 the share of SPF respondents who expect an inflation rate below 1.5% has increased substantially: from an average of 10% between 2014 and 2018, to [above 30]% in 2020-Q3 (Figure 2).

**Figure 1.** Inflation expectations according to different surveys

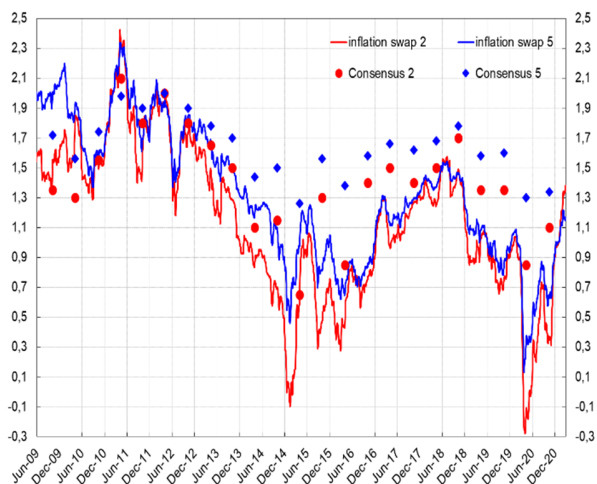


**Figure 2.** Distribution of individual forecasts in the ECB’s SPF

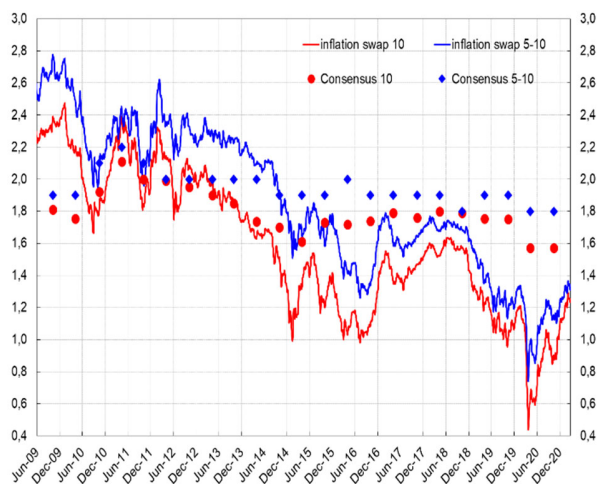


Inflation expectations seem to have deteriorated even more according to market prices of inflation-related financial instruments such as Inflation Linked Swap Rates (ILSRs) and Break Even Inflation Rates (BEIRs) – implied in nominal and inflation linked bonds (Figures 3 and 4). However, these market measures should not be interpreted at face value as pure inflation expectations. In fact, such interpretation would be legitimate only under the unrealistic assumption of investors’ risk neutrality. In reality – in a world populated by risk averse investors – ILSRs and BEIRs incorporate an inflation risk premium, in addition to the expectation, which compensates investors for the correlation of their future endowment with inflation outcomes and can be either positive or negative depending on the sign of such correlation. Disentangling the relative contribution of the subjective inflation expectation and that of the risk premium amounts to solving an “identification” problem. Both quantities are unobservable and their relative importance can only be unravelled based on theory and models. As there are countless possible sets of models and assumptions, there are many possible decompositions, each one as good as the premises it is based on: the fewer and more realistic, the more reliable the decomposition.

**Figure 3.** Short and medium-term survey and market based inflation expectations



**Figure 4.** Long-term survey and market based inflation expectations



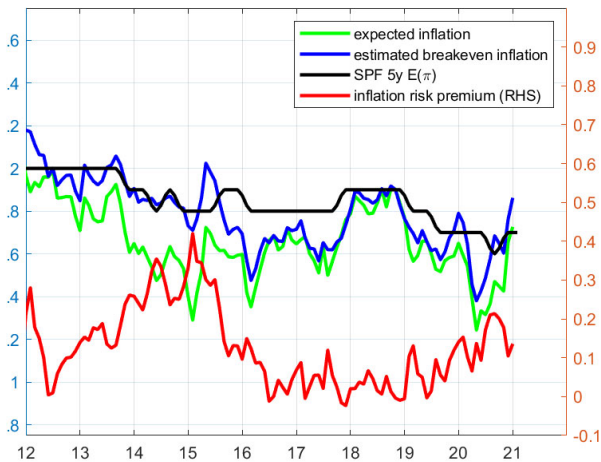
Analyses conducted by Bd'I staff (Pericoli, 2012 and 2014) estimate a small and stable inflation risk premium since mid-2015, suggesting that the signal of rapidly deteriorating inflation expectations provided by market-based indicators for the recent years is a genuine one (Figure 5). The decomposition is based on the assumption that the term structures of both nominal and inflation linked (government) bond yields can be described by an Affine Term Structure Model (ATSM) spanned by a limited number of factors that include, among others, the ECB's SPF-based expectations as well as measures of the liquidity of inflation-indexed bonds. Moreover, Miccoli and Neri (2019) show that in the same years inflation expectations have become more responsive to short-term inflation forecast errors.<sup>1</sup> Other studies, proposed by researchers at Bd'I and based on alternative models, suggest similar conclusions albeit with volatile and sometime negative risk premia (Casiraghi and Miccoli, 2019; Grasso and Pietrunti, 2019). However, decompositions based on different assumptions may lead to alternative conclusions. For instance, those based on the models used by the ECB staff identify an expected inflation component that is broadly in line with the SPF forecasts even in the most recent period.<sup>2</sup> Such decomposition assumes that the term structure of ILSRs can be described by an ATSM that does not include SPF expectations and liquidity measures among its factors (Figure 6). A direct comparison – with the approach adopted at Bd'I – unveils that the method used by ECB staff might rest on less realistic assumptions: Bd'I explicit use of both nominal and real bond yields allows exploiting a richer information set. Moreover, combining market-based with survey-based information and correcting for market liquidity improves the realism of the decomposition.<sup>3</sup>

<sup>1</sup> Garcia and Werner (2018) obtain a similar result.

<sup>2</sup> Camba-Mendez and Werner (2017) and Garcia and Werner (2010).

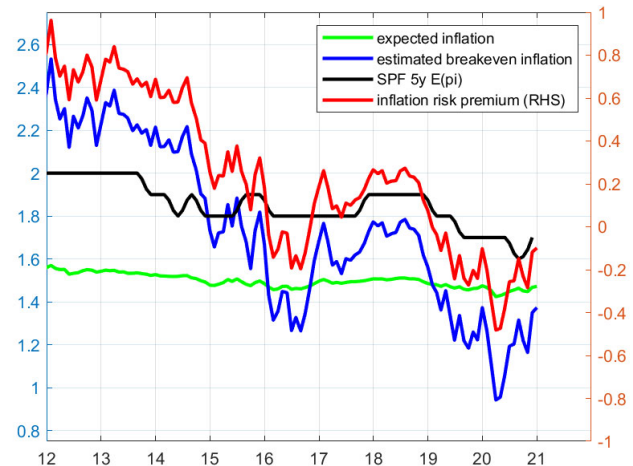
<sup>3</sup> Pericoli (2009).

**Figure 5.** Bdl staff's decomposition of BEIR



Notes: Breakdown of the 5y5y inflation with the standard ATSM model (Bdl) with liquidity correction and survey-based expected inflation, Computation of Banca d'Italia on ECB and Refinitiv Datastream data. The blue line is the 5y5y cash breakeven inflation rate computed with nominal and inflation-linked bonds. The green line is expected inflation. The red line is the inflation risk premium. The dashed black line is the median expected 4 year forward 1-year inflation surveyed by SPF.

**Figure 6.** Decomposition based on model used at ECB



Notes: Breakdown of the 5y5y inflation with the IS-type model (ECB), Computation of Banca d'Italia on ECB and Refinitiv Datastream data. The blue line is the 5y5y cash breakeven inflation rate computed with nominal and inflation-linked bonds. The green line is expected inflation. The red line is the inflation risk premium. The dashed black line is the median expected 4 year forward 1-year inflation surveyed by SPF.

### 3. The risk-neutral probability distribution of future inflation

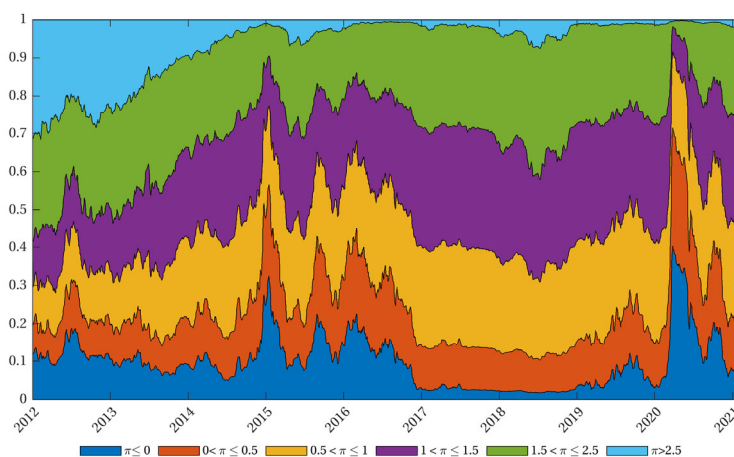
Inflation options – caps and floors – provide further evidence of de-anchoring of long-term inflation expectations, embedded in the implied risk-neutral distribution of future inflation. The estimated risk-neutral probability of inflation falling below 1% – on average in the five years ahead – has increased significantly since 2019, in particular during the peak of the pandemic in the spring of 2020.

The risk-neutral probability distributions of future euro-area inflation, implicit in the valuation of inflation options, are customarily used for risk analysis of the inflation dynamics. Scharnagl and Stapf (2015) document that the information content of such estimates is meaningful in describing aggregate beliefs of market participants on future inflation. According to Smith (2012), option markets on euro inflation are the most liquid – much more than those on GBP and USD inflation – due to different hedging practices of major banks. Moreover, Taboga (2016) shows that even in periods of low liquidity – e.g. during market turmoil – estimation errors can be attenuated with an appropriate methodology. One important caveat must be stressed: without additional assumptions on the shape of the stochastic discount factor, option prices only allow inferring risk-neutral probability distributions, conceptual constructs that are used to price assets as expected discounted cash flows under no-arbitrage. These distributions normally differ from the corresponding subjective probability distributions, as they correct for a risk premium that can be large when investors display great risk aversion and great fear of negative outcomes. As Bauer and Christensen (2014) point out, risk-neutral probabilities assign more weight on outcomes

of which investors worry and want to hedge against – such as deflation or very high inflation. According to Kocherlakota (2013) policy decisions should be based on the evolution of risk-neutral probabilities, rather than subjective ones, precisely because they weigh more the adverse and costly states that consumers and policymakers should guard against.

The risk-neutral distributions signal downward de-anchoring pressures at longer maturities. Inflation options allow estimating the risk-neutral distribution of average inflation over a given time period ahead – corresponding to the maturity of the options – thus the risk-neutral probability that average inflation will fall within a given range.<sup>4</sup> Figure 7 plots the probability distribution of average inflation over the five years ahead. The probability that over this horizon average inflation will be less than 1% – the sum of the blue, orange and yellow areas – has sizeably increased during the peak of the pandemic crisis, reaching about 90 per cent, and, also thanks to the ECB’s interventions, receded back to less than 40% by the end of 2020. Moreover, the mean of the distribution has consistently shifted downwards for all maturities since 2012, with sizeable drops in periods of greater market stress. At the same time the standard deviation has significantly declined, indicating less uncertainty about these forecasts. This evidence confirms the signals highlighted in the previous section and the fact that there is considerable market consensus around them.

**Figure 7.** Risk-neutral distribution of the average inflation rate over the five years ahead, implied by inflation option prices.



*Source:* Based on Bloomberg data. *Note:* the Figure reports the 5-day moving average of expected inflation implicit in zero-coupon inflation options written on the rate of growth of the euro-area HICP over a five-year horizon. Risk-neutral probabilities may differ significantly from physical, or true, probabilities. Latest observation: 9 November 2020.

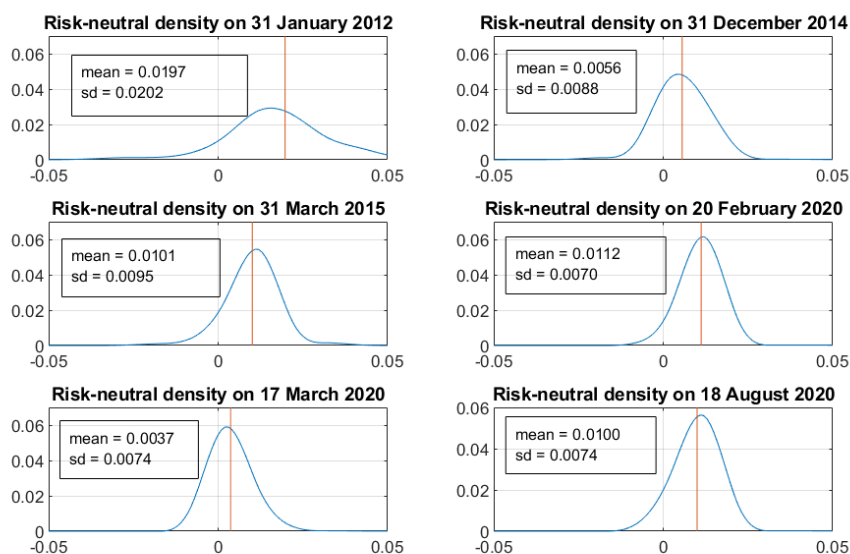
The risk-neutral density of the euro-area inflation, in the 5 years ahead, has moved over time as consequence of both exogenous economic developments and ECB’s unconventional monetary policy measures. The changes have affected all moments of the distribution: its mean – approximately the ILS rate – its standard deviation – approximately the consensus around the mean – and its skewness – a

<sup>4</sup> For details of the methodology, see Cecchetti et al. (2015).

measure of the asymmetry of down- and up-side risks. Figure 8 illustrates six snapshots, at significant dates:

- 31/01/2012 : expected inflation near the ECB target, with considerable dispersion;
- 31/12/2014 : delayed ECB response to the deflationary risks and expected inflation below target;
- 31/03/2015 : after the launch of EAPP (01/2015);
- 20/02/2020 : eve of spread of COVID pandemic to the euro area;
- 17/03/2020 : height of the pandemic crisis;
- 18/08/2020 : five months after PEPP announcement, distribution returned at pre-pandemic level.

**Figure 8.** Risk-neutral densities at different dates



*Source:* Based on Bloomberg data. *Note:* the Figure reports the option-implied risk-neutral inflation densities and the mean value (red line) at different dates, for the 5-year maturity.

#### 4. Survey-based measures of long-term inflation expectations

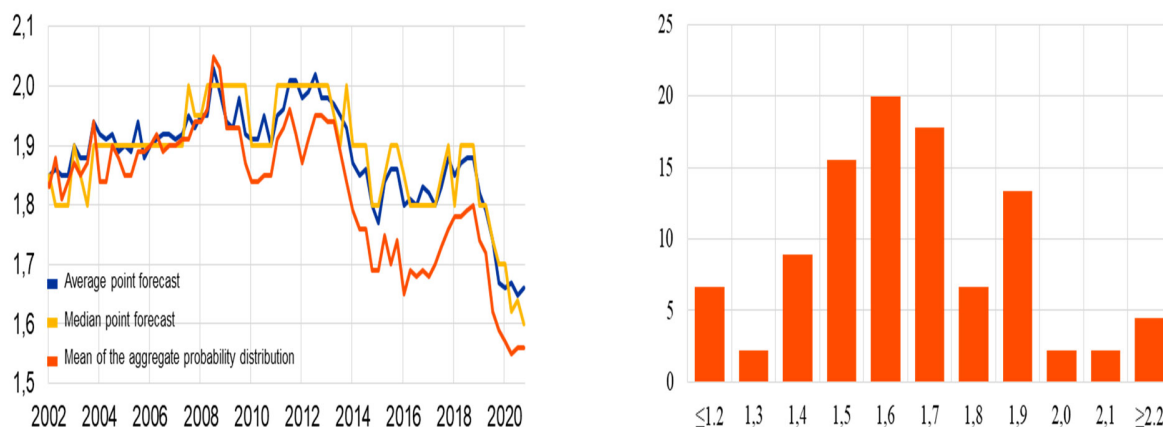
Measures of long-term inflation expectations obtained from surveys of professional forecasters show signs of de-anchoring. Their values have never returned to the levels that used to prevail before the 2013-14 disinflation. Moreover, they have become more sensitive to short-term expectations and to negative inflation surprises.

The notion of de-anchoring of expectations is complex and multi-faceted, with no single definition or measure. Traditionally, much of the de-anchoring literature has focused on two main approaches to assess it: (i) examining the level of inflation expectations – especially long-term ones – in particular relative to an inflation target and/or (ii) the responsiveness of long-term inflation expectations to short-term developments – e.g. actual inflation or other economic news.

The ECB Survey of Professional Forecasters provides evidence that longer-term inflation expectations may have become de-anchored from the ECB’s inflation aim. This is evident in the fact that they have never returned to the level that prevailed before the 2013-14 period of disinflation (Figure 9, left panel). Moreover, they have become sensitive to short-term inflation expectations and to negative inflation surprises (Corsello *et al.*, 2019). In the most recent waves, one third of the SPF participants’ long-term inflation expectations were below or equal to 1.5%, compared to less than one sixth with expectations equal to 1.9% (Figure 9, right panel). Such disagreement can be viewed as an alternative measure of de-anchoring (Kumar *et al.* 2015), corroborating the findings of de-anchoring based on the level analysis.

**Figure 9.** ECB Survey of Professional Forecasters

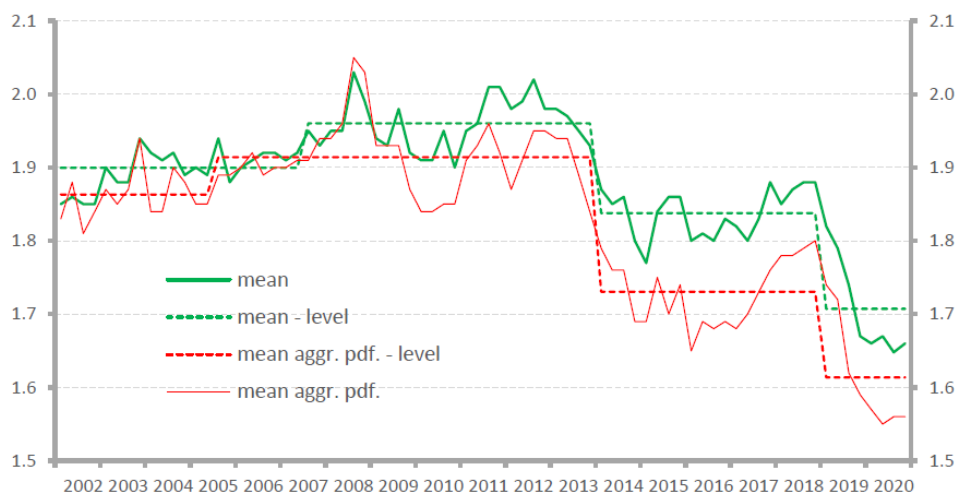
a) Longer-term inflation expectations      b) Distribution of point expectations



Note: chart in panel b) is based on the results of the October 2020 survey round. Longer-term inflation expectations refer to four/five years ahead inflation forecasts.

A level-shift analysis provides further evidence of de-anchoring (Corsello *et al.* 2019). Long-term inflation expectations are level-anchored when they remain stable at the level of the central banks’ target regardless of the changes in current inflation; they are shock-anchored when they do not respond to shocks. Using the methodology of Bai and Perron (2003), the paper estimates a structural regime break in the level – the constant – of predicted expectations at the end of 2013, providing evidence that forecasters have permanently revised their expectations. Corsello and Neri (2020) update the analysis using data up to 2020:Q4 and document a new downward shift of 15 bps from the beginning of 2019, which adds up to a total of 30 bps with the shift occurred in 2013 (Chart 13).

**Figure 10.** ECB SPF long-term expectations: level-shift analysis



Source: ECB's Survey of Professional Forecasters.

Note: the Bai and Perron (2003) procedure is calibrated to allow for a maximum of 5 structural breaks, each of a minimal length of 8 quarters. Sample period: 2002:2 – 2020:4.

Bulligan (2021) studies the anchoring of long-term inflation expectations exploiting the panel dimension of the Survey of Professional Forecasters. The econometric panel analysis shows, in line with Corsello, Neri Tagliabracci (2019), that long-term inflation expectations have de-anchored, as suggested by significant downward shifts in their mean level and by their sensitivity to short-term inflation news. Corsello, Neri and Tagliabracci (2021) study the evolution of the joint probability distribution of real GDP growth and inflation expectations in the euro area using the Survey of Professional Forecasters. The authors find that the likelihood of low inflation and low growth outcomes has gradually increased over time, reflecting the weakened anchoring of long-term inflation expectations and the adverse macroeconomic impact of structural factors and of the financial and sovereign debt crises. The gradual changes in the joint distribution of growth and inflation are consistent with a switch in forecasters' view about the relative importance of supply and demand shocks, with the latter gaining prominence since the sovereign debt crisis.

## 5. Households' and firms' inflation expectations and their determinants

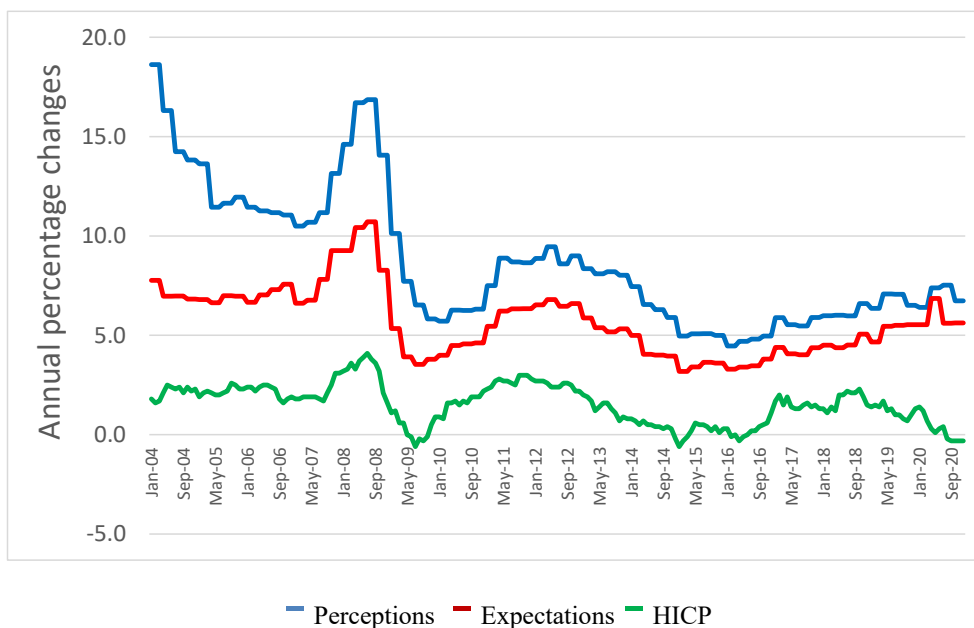
A central tenet of dynamic economic theory is that agents' behaviour crucially depends on their individual inflation expectations. These are indeed measurable, with well-designed hypothetical survey questions. Bd'I has a tradition of collecting them in its surveys. The SHIW, a broad biannual household survey with very detailed information – on wealth, income, savings, socio-economic characteristics – collected since the 1960s, contains questions on inflation expectations in some of its waves. The SIGE, a broad quarterly business survey collected since 1999, contains questions on firms' point expectations

of future HICP inflation, at different horizons, and on own future selling price changes.<sup>5</sup> Firms' expectations have been scarcely investigated, compared with the attention paid to expectations of consumers and professional forecasters, surprisingly given that firms ultimately set prices and wages. Bd'I's SIGE is an exception in this respect.

### 5.1 Households

Consumers' expectations appear to be strongly biased, according to evidence in the literature: both perceived and expected inflation are in general much higher than measured inflation. Figure 11 shows inflation perceptions and expectations reported by euro area consumers. The difference between consumers' perceptions and expectations, on the one hand, and actual inflation on the other, increased during the global financial crisis. After the crisis, the difference narrowed but remained high, at around 5 percentage points, on average (Reiche and Meyler, 2021). However, despite being systematically higher, movements in consumers' expectations are synchronous to those of inflation, suggesting that households are somehow aware of inflation developments. Table 1, which shows households' expectations together with those of firms and professional forecasters in the case of Italy, confirms that consumers' beliefs are much higher than those of other agents.

**Figure 11.** Actual inflation and consumers' perceived and expected inflation



Source: European Commission and Eurostat. Perceptions: mean of consumers' quantitative estimates of inflation perceptions, based on the question: "By how many per cent do you think consumer prices have gone up/down over the past 12 months?" Expectations: mean of consumers' quantitative estimates of inflation expectations, based on the question "By how many per cent do you think consumer prices will go up/down over the next 12 months?".

<sup>5</sup> Conflitti and Zizza (2020) illustrate details on SIGE data and on other sources – for other countries – as well as on the factors shaping inflation expectations.



**Table 1.** Short-term (12-month-ahead) expectations on consumer inflation

	Italy (2004-2019)		
	Data source	Mean (%)	Standard deviation
Inflation expectations of consumers	EC <sup>(3)</sup> consumer survey	4.5	1.8
Inflation expectations of firms	SIGE <sup>(1)</sup>	1.7	1.0
Inflation expectations of experts	Quarterly Consensus Economics <sup>(2)</sup>	1.6	0.5
HICP inflation	Eurostat <sup>(3)</sup>	1.6	1.1

Notes: <sup>(1)</sup> quarterly data, 2006Q1-2019Q4; <sup>(2)</sup> quarterly data, 2004Q1-2019Q4; <sup>(3)</sup> monthly data, 2004:01-2019:12.

The upward bias of consumers' expectations could be partly ascribed to the way households' expectations are gathered. The experience at Bd'I, based on the SHIW, shows that when inflation expectations are collected using probabilistic questions – instead of asking for a point estimate, as in the European Commission survey – households correctly reveal their expectations, providing values that prove to be in line with official releases (Rondinelli and Zizza, 2020).

Several factors drive consumers' inflation expectations – socio-demographic characteristics, supply-side bias, purchasing experience, news on current inflation – according to a considerable number of studies using both U.S. and euro area surveys. The main findings are the following. First, socio-demographic characteristics play a key role: women, lower income earners and individuals with lower level of education tend to perceive and expect higher levels of inflation (Pfajfar and Santoro 2008, Del Giovane *et al.* (2009), Binder 2015, Arioli *et al.* 2017, among others). Second, households' beliefs about inflation appear consistent with a supply-side narrative (Candia *et al.* 2020): when consumers perceive a deterioration in the general economic situation, they raise their inflation perceptions or expectations.<sup>6</sup> Relatedly, consumers with pessimistic attitudes about the macroeconomy or their economic or financial situation are likely to have higher inflation expectations (Ehrmann *et al.* 2017).<sup>7</sup> This is consistent with the well-known findings that consumers are more receptive to bad news than to good news (see, e.g., Baumeister *et al.* 2001) and that financially constrained consumers are more attentive to price changes of the goods they purchase than more affluent consumers (Snir and Levy 2011). Third, inflation expectations are mostly shaped by consumer's purchasing experience. The inflation rate of consumption baskets that relate to the socio-economic group to which the individual belongs matters much more than overall inflation in driving consumers' inflation expectations (Pfajfar and Santoro, 2008; Menz and

<sup>6</sup> This might explain why in the midst of a COVID-19 outbreak, as well as during the early stages of the Great Recession, inflation forecasts of consumers have increased, rather than fallen like those of professional forecasters. This pattern was common to US and to Germany, France and Italy.

<sup>7</sup> Premik and Stanisławska (2017), Del Giovane *et al.* (2009) and Rondinelli and Zizza (2020) provide consistent evidence.

Poppitz, 2013). Also, in forming their expectations, households are more likely to be influenced by changes in prices of the items they purchase at high frequency (e.g. Coibion and Gorodnichenko 2015, Georganas *et al.* 2014).<sup>8</sup> Moreover the inflation experience that individuals have undergone over their lifetime affects their inflation expectations (Malmendier and Nagel, 2016). This would explain why long-run inflation expectations of older cohorts, who experienced the high inflation period of the 1970s, appear less anchored as compared to the young cohorts (Dräger and Lamla, 2018). Finally, consumers' inflation expectations are responsive to news on current inflation. Ehrmann *et al.* (2017) find that more intense media coverage reduces the bias and improves forecast accuracy.<sup>9</sup> More in details, consumers with more strongly upward-biased expectations are more responsive to media coverage, and their bias shrinks by more than the other consumer groups. This is clearly crucial for the debate on monetary policy communication, as a more intense reporting about inflation would improve consumers' inflation expectations, especially those of consumers in the right tail of the distribution.

## 5.2 Firms

Various factors drive firms' inflation expectations, according to Bd'I studies: the monetary policy stance and its communication, the dynamics of wages and input prices, the awareness of news on current inflation. Empirical research conducted using SIGE data suggests that the monetary policy stance drives firms' expectations and that the reaction is even stronger in case of unconventional monetary policies (Bottone and Rosolia, 2019). Moreover, firms' expectations are affected by wage increases set by contract renewals and the prices of raw materials. Being informed with the latest official inflation data also influences firms when forming their beliefs (Conflitti and Zizza, 2020). On the other hand, the lack of knowledge about current inflation affects the dispersion of Italian firms' inflation expectations. About half of the disagreement on inflation expectations among Italian companies is attributable to a lack of information about the most recent inflation developments, with the remaining cross sectional dispersion related to developments in selected economic aggregates; however, firms incorporate new information on inflation into their expectations quickly, within one quarter after its release (Bartiloro *et al.*, 2019). The dispersion of firms' expectations, moreover, is higher when inflation is farther away from the ECB's price stability goal, when its short-term swings are larger and when price developments of HICP items are more heterogeneous (Bartiloro *et al.*, 2019).

Firms' inflation expectations are positively correlated with current inflation. Figure 12 shows that firms' inflation expectations at different horizons tend to strongly co-move with the actual inflation dynamics (black solid line). More importantly, this finding holds both for firms who received an

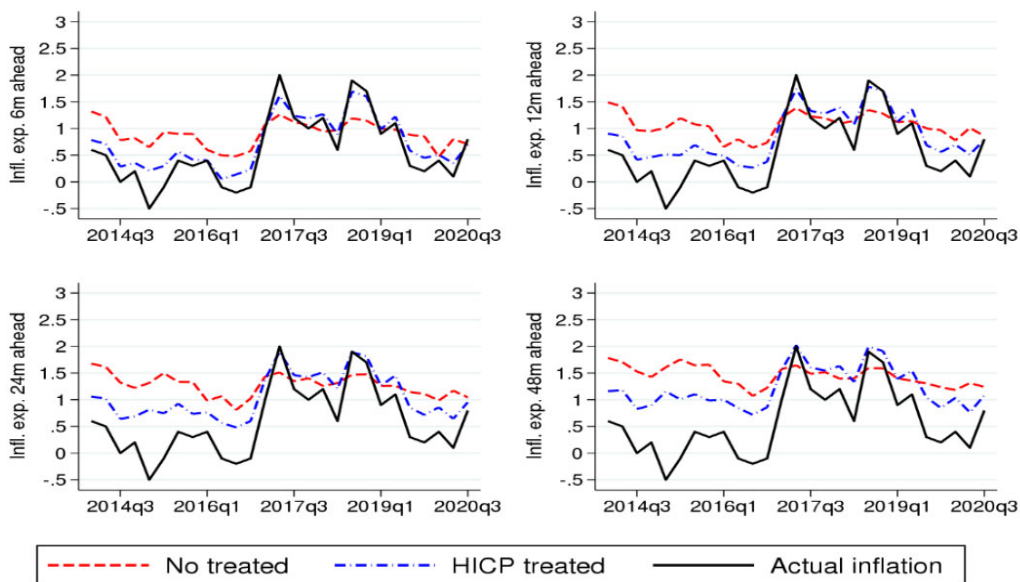
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<sup>8</sup> The "frequency bias" could have been a relevant driver of the increase in households' inflation expectations during the COVID-19 outbreak. Indeed, owing to the restrictions on mobility and consumption imposed by the public health emergency, food prices, whose increase was markedly higher than the general price index, were much more "visible" to households than the prices of other items that they were not able to purchase. In the aftermath of the Great Recession the rise in household inflation expectations from 2009 to 2011 can be explained by the increase in oil prices over this time period (Coibion and Gorodnichenko 2015), as gasoline prices are among the most visible prices to consumers. A relation between consumers' inflation perceptions and the larger increases in the prices of frequently purchased products had also been observed in 2002, following the euro cash changeover (Del Giovane and Sabbatini, 2006; on the behaviour of consumers' inflation perceptions following that event, see also other studies collected in Del Giovane and Sabbatini, 2008).

<sup>9</sup> Media coverage is measured by the intensity of news coverage related to inflation in the NYT and the Washington Post.

information treatment about last inflation figure (blue line) and for firms who did not receive any treatment (red line).

**Figure 12.** Firms’ inflation expectations at different horizons



Source: authors’ calculations on SIGE data.

## 6. The effect of agents’ inflation expectations on their economic choices

Households’ inflation expectations have a causal effect on their consumption, via both intertemporal substitution and income effects. Even though this is undisputed, the empirical evidence on the sign of the net effect is mixed in the literature. A study by Bd’I staff suggests that the sign may vary over time depending on the inflation regime and the presence of indexation mechanisms. Firms’ inflation expectations also have causal effects on their behaviour, which, consistently with New Keynesian models, vary depending on whether monetary policy is constrained at the ELB.

### 6.1 Households

The literature has brought forward conflicting evidence on the role of inflation expectations on households’ spending behaviour. Expectations affect current consumption, via both intertemporal substitution and income effects. In a cross section, households with higher inflation expectations perceive lower real interest rates than other households, given that nominal interest rates are traded and thus common. By intertemporal substitution, this gives them an incentive to spend more today. At the same time, higher inflation rates lower the nominal net present value of their lifetime purchasing power, providing incentives to save more today via an income effect. Whether higher expectations lead to higher consumption or higher saving depends on the relative importance of the income and substitution effects.

According to a study by Bd'I staff (Rondinelli and Zizza, 2020), there is empirical evidence based on SHIW data that two different regimes have characterized the Italian economy: during the recent period of low inflation, households with higher inflation expectations have reported a lower readiness to purchase durables when compared to the other households, as the income effect has prevailed. This evidence is in line with the estimates in Coibion *et al.* (2019) and the income effect argument also raised by Candia *et al.* (2020): if inflation is viewed as having supply-side origins, and thus is associated with bad economic conditions, households who expect higher inflation may reduce their spending. On the contrary, during the high inflation of the early 90s, full wage-indexation has neutralized the income effect: only substitution has mattered, so that households with higher inflation expectations have anticipated expenditure more than the others.

## 6.2 Firms

The unique “experimental” design of the SIGE has allowed to establish that inflation expectations do have a causal effect on firms’ economic decisions – such as pricing, financing, investment and hiring choices – to identify it and to measure it. This has been possible by exploiting the exogenous variation generated by a randomized information treatment purposefully constructed into the survey. The wording of the question has been randomized, starting from the third quarter of 2012: the sample has been randomly split into two groups and two respondents out of three have been provided with a nominal anchor for current inflation – the latest available official figure before the questionnaire is sent – while the others have not.<sup>10</sup>

Two papers involving Bd'I staff have exploited the random variation built into this experimental design. The main conclusion of Coibion *et al.* (2020) is that, while on average Italian firms have interpreted inflation news as supply-side driven – as also argued in Candia *et al.*, 2020 – when the ELB has been binding they have tended to perceive a stronger demand-side channel. In fact, over the entire sample (2012-2017) – that is both “pre” and “post” the start of the ELB regime – higher inflation expectations have driven prices and planned activity in opposite directions, consistently with firms perceiving a supply-side channel of inflation news. Firms with exogenously higher inflation expectations have raised their prices, reduced capital and employment more relative to firms with lower expectations – the latter with a lag. Concentrating only on the subsample when policy rates have been at the ELB, instead, higher inflation expectations have shifted prices and planned activity more in line with a demand-side channel: the effect of inflation expectations on prices has become stronger, while that on capital and employment has become negligible. This finding is in line with the implications of New Keynesian models at the ELB: the inability/unwillingness of the monetary authority to change nominal interest rates implies that lower/higher inflation expectations do not automatically generate an expectation of – more than proportionally – lower/higher nominal rates, as the Taylor principle would prescribe outside the

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<sup>10</sup> The untreated question has always been: “*What do you think consumer price in Italy, measured by the 12-month change in the harmonized index of consumer prices, will be in 6, 12 and 24 months?*”. The nominal anchor was provided to all respondent up to the second quarter of 2012. Moreover, since the beginning of 2017, the share of informed and non-informed respondents has been changed as follows. For 3 out of 5 firms in the sample the standard nominal anchor is provided; for 1 out of 5 there is no nominal anchor and for the remaining fraction the information on the ECB inflation target (i.e. below but close to 2% in the medium term) is given.

ELB, and translate into expectations of lower real rates. The paper by Rosolia (2020) reaches conclusions that are only partly similar, using a different estimation method – a period-by-period analysis rather than a panel regression – and focusing on contemporaneous effects and on outcomes available from SIGE data only, namely employment and own prices. Similarly to Coibion *et al.* (2020) he finds no effect on impact on labour demand; by contrast, he does not find a significant causal effect on price decisions.

## 7. The role of inflation expectations in macroeconomic models

Inflation expectations play an important role in macroeconomic models: by affecting consumption and investment decisions – via the real interest rate – on the demand side, by guiding wage and price formation on the supply side, by influencing the exchange rate and asset prices. Simulations, conducted with the Quarterly Econometric Model and with a medium-scale closed-economy Dynamic Stochastic General Equilibrium Model, suggest that a temporary 50 bps shock to inflation expectations induces a peak increase of real GDP in a range of 0.1 - 0.3 per cent and a gradual rise in consumer prices by nearly 50 bps. In the first year, the effect on the GDP growth rate is between 0.08 and 0.12 p.p., that on inflation between 0.22 and 0.44 p.p.

Inflation expectations enter macroeconomic models through different channels. On the demand side, changes in expected inflation translate directly into changes in real interest rates that affect consumption and investment choices of households and firms. From a supply perspective, inflation expectations contribute to wage and price formation. Shocks to inflation expectations can also reflect both current and prospective monetary policy developments and hence can generate an immediate response of exchange rates and asset prices. Macroeconomic models generally incorporate all these channels, although the transmission mechanism throughout the economy can differ to some extent, according to the underlying assumptions.

Semi-structural models and micro-founded structural models (DSGEs) generally incorporate expectations in different manners. Semi-structural models, like Bd'I quarterly econometric model, link inflation expectations to observable indicators, such as those obtained from surveys of analysts, firms or households, leaving room for a backward looking component of expectations. Micro-founded structural models (DSGEs) assume rational expectations, so that expectations are model consistent and purely forward looking. Nonetheless, they may be flexible in allowing for temporary deviations from rational expectations.<sup>11</sup>

The following subsections describe the role of inflation expectations in the semi-structural and DSGE models used at Bd'I for forecasting and policy purposes. For each model, a quantitative exercise is also presented aimed at shedding light on the macroeconomic implications of shocks to inflation expectations. It must also be noted that the interplay between inflation expectations and the macroeconomy can be state-dependent and non-linear, due for example to downwards wage and price rigidities, the effective lower bound on the monetary policy rate, reduced perceived credibility of the

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<sup>11</sup> See e.g. Angeletos *et al.* (2018).

central bank inflation aim and possible de-anchoring. We will abstract from these issues in the results presented below.

### ***7.1 Inflation expectations in Bd'I quarterly econometric model***

The measure of inflation expectations used in the Bd'I quarterly econometric model (BIQM) is based on survey data<sup>12</sup>. Short-term inflation expectations are measured with the (quarterly series of) 1-year ahead forecasts published by Consensus Economics. The series is made endogenous according to a backward looking equation that includes past inflation, exchange rates, commodity prices and output gap developments. A second, smoother, indicator of longer-term inflation expectation is constructed as a partial adjustment equation which reflects the assumption of adaptive expectations.

In the BIQM, an increase in inflation expectations affects the economy via three main channels:

- Demand. Changes in longer-term inflation expectations affect the real interest rate, which shapes households' choices over consumption and saving and firms' investment plans. Along this channel, an increase in inflation expectations is associated to an expansion of domestic demand and GDP; the ensuing demand pressures will then have a (second order) impact on prices.
- The Phillips curve. Shorter-term inflation expectations are a key determinant in wage negotiations and therefore enter directly in the wage Phillips curve of the model. An increase of inflation expectations translates into higher wages and labour costs that are gradually transmitted to consumer prices. At the same time, higher production costs imply a loss of competitiveness, negatively affecting exports. The impact on real GDP along this channel is negative.
- The exchange rate. An immediate response of the exchange rate may follow a shock to inflation expectations, e.g. if this is related to monetary policy developments. In case of an increase in expected inflation, the exchange rate depreciation rises the price of imported goods and hence affect the purchasing power of households. The negative impact on domestic demand is offset by the increase in competitiveness, which sustain exports and domestic production.

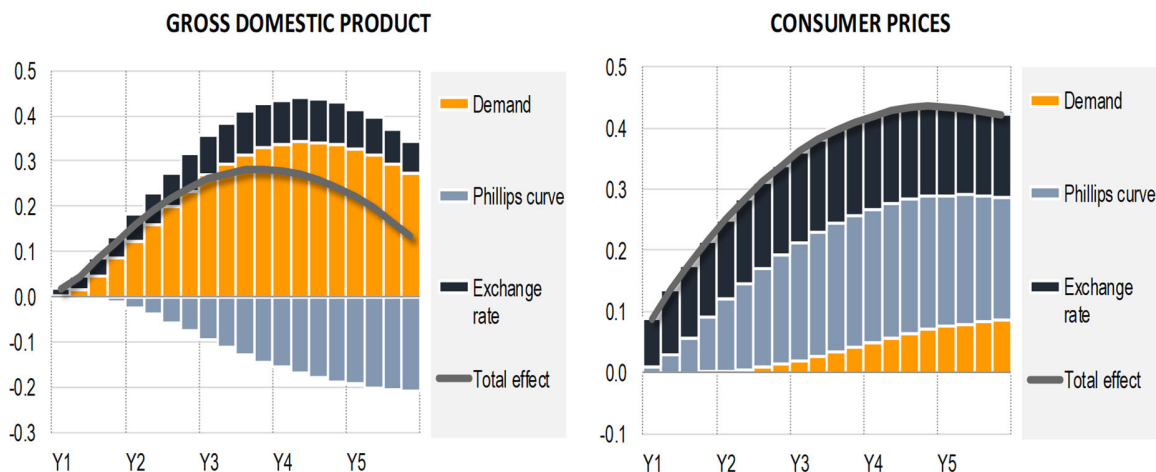
The impact of a shock to inflation expectations, along the three channels described above, has been quantified with a simulation exercise. We have assumed a temporary shock of 50 basis points to inflation expectations in the first quarter with a gradual return to baseline levels afterwards. Three simulations were run, where the shock to expectations affects one transmission channel at a time – holding the other two fixed – and the monetary policy rate is kept unchanged. Figure 13 shows the results of the exercise. At the peak GDP is about 0.3 percentage points higher than in the baseline, mainly thanks to the impact of the lower real interest rates in the demand channel. Consumer prices increase gradually, reaching a peak of nearly half percentage point. The main driver of higher prices is the Phillips curve channel, while

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<sup>12</sup> See Bulligan et al. (2017) for a recent description of the main properties and equations of the Banca d'Italia econometric model.

the impact of demand pressure is relatively low; the depreciation of the exchange rate, which is assumed to follow an estimated reduced form model, accounts for about one third of the total effect on prices.<sup>13</sup>

**Figure 13.** Impact on GDP and consumer prices of a temporary shock to inflation expectations in the Bd'I quarterly econometric model



## 7.2 Inflation expectations in the Bd'I DSGE models

Micro-founded DSGE models are typically solved under rational expectations, so that inflation expectations are model consistent. Households and firms are forward-looking and, in the absence of uncertainty, their current decisions factor in all relevant information about the current and future state of the economy, including the observed realization of a shock and/or policy announcements about, e.g., the current and future path of the monetary policy rate, or tax rates.

Inflation expectations affect economic activity through: i) an Euler equation, according to which current and future expected variations in the real interest rate – i.e., the nominal interest rate net of inflation expectations – negatively affect current consumption; ii) a forward-looking Phillips curve, derived from the solution to the firms' intertemporal pricing problem, which implies that current inflation is determined by real marginal costs and inflation expectations.

The combination of Euler equation, Phillips curve, and a Taylor-type rule for the nominal interest rate provides the essential description of the economy: inflation expectations influence aggregate demand via the real interest rate – for a given nominal rate –; aggregate output in turn determines current inflation – via marginal costs – for a given level of inflation expectations.

<sup>13</sup> The euro vs. dollar exchange rate follows an estimated equation that includes as covariates the lagged dependent variable, euro area inflation expectations and the output gap differential between the euro area and the US. According to this equation, the temporary shock of 50 basis points to inflation expectations assumed in our exercise translates into an immediate exchange rate depreciation of about 1.5% with a gradual return to baseline afterwards.

In large-scale models used for policy analysis, this mechanism is enriched with nominal wage rigidities and investment in physical capital.<sup>14</sup> Furthermore, in an open-economy setup, a Phillips curve arises for both domestically produced and imported goods. Both domestic and imported goods inflation expectations thus influence domestic inflation. An uncovered interest parity condition links exchange rate fluctuations to cross-country interest rate differentials. Hence, inflation expectations ultimately influence real exchange rate developments and trade competitiveness.

Estimated large-scale DSGE models, used for policy analysis, typically do not include measures of inflation expectations as observables. However, Del Negro and Eusepi (2011) show that adding inflation expectations increases the fit of a typical DSGE model, as they contain additional information. Christoffel et al. (2020) perform a similar exercise on euro-area data and reach similar conclusions. Nonetheless, the choice of which inflation expectations measure to include is not straightforward and it may have a significant impact on the results.

While inflation expectations are in general forward looking and model consistent, it is possible to introduce temporary deviations, for instance by introducing temporary shocks to expected inflation in the model. For illustrative purposes, we present a quantitative exercise using a simple closed-economy model similar to Smets and Wouters (2003). It is assumed that – due to exogenous, non-modelled factors, possibly related to the perception of a looser monetary policy stance – agents in the economy temporarily revise their inflation expectations upwards by 50 basis points.<sup>15</sup> The impact on GDP and inflation is showed in Figure 14.

We consider different scenarios. A first one in which households incorporate higher inflation expectations – and therefore a lower current and expected real interest rate – in their consumption and saving decisions, while wages and price formations are not directly affected. Aggregate demand expands, driven by a lower real interest rate, and GDP rises by about 0.3% – in deviations from its steady-state level – while the impact of demand pressures on prices is low. In the second scenario, we assume that the temporary shock to inflation expectations only enters the firms’ pricing equation, in order to isolate the supply-side transmission channel. Inflation increases by nearly 0.5 percentage points while GDP falls by about 0.2%. Finally, in the compounded scenario, where the demand and supply channels are simultaneously activated, both inflation and GDP are higher than in the baseline.

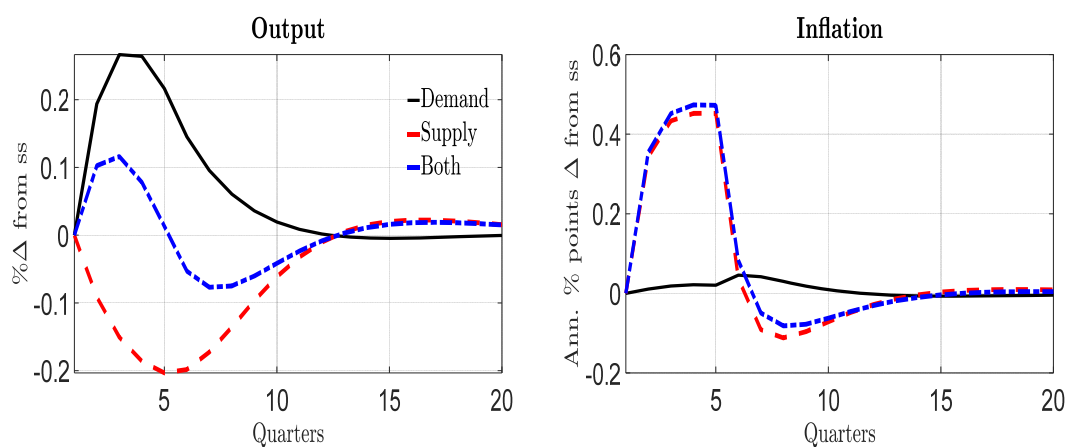
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<sup>14</sup> See e.g. Bartocci et al. (2017).

<sup>15</sup> It is also assumed that the central bank keeps the short-term nominal interest rate at its steady-state value for the first three quarters and then follows a Taylor-type rule.



**Figure 14.** Impact on GDP and inflation of a shock to inflation expectations in a closed-economy DSGE model under temporary deviations from rational expectations



## 8. Conclusions

This paper illustrates the tools used at Bd'I to monitor the evolution of inflation expectations and it surveys the analyses that have assessed how they affect agents' choices and the real economy.

Market-based indicators of long-term expectations have displayed clear signs of de-anchoring. Even though their dynamics have been partly driven by the inflation risk premium, analyses conducted by Bd'I staff have estimated a sizeable role of the expectation component. Measures of long-term expectations obtained from surveys of professional forecasters have also shown signs of de-anchoring. Their values have never returned to the levels that had prevailed before the 2013-14 disinflation. Moreover, they have become more sensitive to short-term expectations and to negative inflation surprises. Analyses based on the surveys of households' and firms' inflation expectations have shown that they are key drivers of economic choices. Households' inflation expectations cause consumption, via both intertemporal substitution and income effects, and firms' inflation expectations cause their pricing, investment and employment decisions. From a macro-modelling perspective, inflation expectations play an important role by affecting consumption and investment decisions on the demand side – via the real interest rate – by guiding wage and price formation on the supply side, by influencing the exchange rate and asset prices.

Further theoretical and empirical research is warranted, to shed light on the mechanisms behind the formation of inflation expectations and to understand the impact of monetary policy communication on such mechanisms, a key issue in light of the on-going review of the ECB's monetary policy strategy. Further investigation should especially be directed to finding new sources of information on households and firms' expectations, to support monetary policy.

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