Inflation expectations: models and measures
Abstract

Inflation expectations are key inputs into monetary policy, but they also represent one of the most difficult variables to measure. Inflation expectations are particularly difficult to pin down in a low inflation environment in which important relative prices experience large changes. The available measures of inflation expectations differ widely across different sources and could be used at most as an additional element in monetary policy decisions, but not as a target.

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<tr>
<td>ECB</td>
<td>European Central Bank</td>
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<tr>
<td>GDP</td>
<td>Gross domestic product</td>
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<td>HICP</td>
<td>Harmonised index of consumer prices</td>
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<td>OAT</td>
<td>Obligation assimilable du Trésor</td>
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<td>SPF</td>
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EXECUTIVE SUMMARY

- **Inflation expectations are considered key to monetary policy** as they play an important role in economic agents’ prices and wage-setting decisions.

- **Different measures of inflation expectations matter to different economic agents.** In practice, households, firms, and financial markets form their inflation expectations by looking at the dynamics in different prices (goods, services, wages and assets). Theoretical models’ assumptions tend to deviate from reality.

- **The measures of inflation expectations used in models and by central banks to forecast future inflation are, in most cases, not representative of heterogeneous groups of firms and households.** Typically, the Survey of Professional Forecasters (SPF) is used, which, to a large extent, relies on financial markets expectations and provides numerical expectation measures.

- **The overview of available measures of actual inflation suggests differences across indicators relevant to different agents, as well as in their inflation expectations.** Such differences tend to be more relevant in an environment of low inflation in which relative prices (e.g. energy or food versus services) experience large changes. This is the case in the current environment.

- **In the EU, wage setting is a key moment in which inflation expectations affect actual inflation in a persistent manner** given that in most countries, wage negotiations have a two-year time horizon.

- **In the euro area, current inflation expectations do not seem to imply the potential for inflationary pressures.**
1. **INTRODUCTION**

Inflation expectations are considered key to monetary policy because they affect households, firms and financial markets’ decisions about how they spend, save, set prices and wages and invest. Such choices affect the economy as a whole and hence actual inflation. Inflation expectations are incorporated into macro-economic models and in central banks’ formulation of their own inflation expectations to set an informed monetary policy. However, as it will be argued below, accounting for the different ways inflation expectations are formed across different agents in the economy is a very complex exercise. Figure 1 offers an overview of the economic agents, the key variables for transmission mechanisms relevant to them and (traditional) economic models’ design features.

In practice, there are three key variables for which inflation expectations are relevant: i) the real interest rate (defined as the difference between the nominal interest rate and the expected inflation rate), which affect companies’ investment and households’ intertemporal choice between consumption and saving, ii) wage setting, which should maintain the purchasing power of consumers, and iii) the price setting by companies, which should incorporate future prices of factors of production (including capital and intermediate goods).

In traditional micro-funded macroeconomic models, households’ optimal choice (utility maximisation) is defined through the Euler equation, and companies’ price setting is the result of the profit maximisation (accounting for the degree of competition in the market). At aggregate level, the Phillips curve, which is a synthesis of the relation between prices and labour market performance, defines the dynamics between inflation (inflation expectations) and wages.

**Figure 1: Overview of how inflation expectations affect economic agents’ choices and how models take them into account**

Source: Authors’ elaboration based on ECB (2021a), p. 12.

Theoretical models developed by Phelps (1967), Friedman (1968), and Lucas and Rapping (1969) were the first to explicitly incorporate inflation expectations into a Phillips curve relation. The more recent
version of this relationship is the micro-founded New Keynesian Phillips curve (NKPC) that characterises current inflation as a function of firms’ expectations about future inflation and a firm’s marginal cost.

In practice, different agents are interested in different categories of prices that are relevant to their future choices. However, in traditional models, agents are homogeneous and they form their expectations in a rational way (i.e. no information asymmetry exists), hence their expectations converge to a single value. In this framework, most economic models concentrate on “the” price level, usually of the only good (which could be a composite) and a representative agent who forms expectations to guide their consumption choices. Implicitly, it is thus the consumer prices index which matters for the so-called Euler equations, which in many models determine consumption choices based on the difference between (nominal) interest rates and expected price increases. Similar reasoning applies to firms’ profit maximisation.

In these models, the central bank sets monetary policy following a rule, in which the interest rate responds to output developments (i.e. the output gap, but possibly also employment) and incorporates the inflation expectations of the representative agent.

In recent times, many of the models’ assumptions illustrated above have been challenged and new models developed but, above all, the problem facing the European Central Bank (ECB) (and other central banks) at the present juncture does not seem to be addressed by the features of most models.

First, the price of one important input, energy, has increased dramatically, implying that the price expectations of consumers might diverge greatly from that of producers of industrial goods.

Second, different sectors of the economy have been impacted in very different ways by the COVID-19 recession and recovery, making “one good” models even less representative of the current reality.

Third, some demand-supply mismatch induced by the rebound after the pandemic is creating market frictions. Different agents might thus form very different expectations as different prices matter for them; and in some extreme cases, the price might no longer matter because the good or service is no longer available.

Regardless of the model, in real life, there are two broad ways to measure inflation expectations. One is to ask firms and households through surveys about their expectations for future prices. This approach has the advantage that one can directly ask those who set the price of and buy goods and services, i.e. business managers and households. The disadvantage is that the respondents have no strong incentive to make the right prediction, as the replies are only entries into a spreadsheet and have no real implications for them. The other approach uses financial market information from securities, which are directly linked to inflation (see section 3 for concrete examples). The advantage of these market-based measures is that the investors in these instruments have a strong incentive to get the result right.

As it is illustrated more in detail below, the ECB monitors all these indicators, but it mostly relies on a specific source of inflation expectations, namely the Survey of Professional Forecasters (SPF).

Importantly, inflation expectations are considered as a measure of credibility of the central bank's inflation target. Inflation expectations that are well anchored to the monetary policy objective ensure the monetary policy transmission and reduce inflation persistence, therefore inflation expectations are generally assumed to be important determinants of actual inflation outcomes.

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1 More recently, models with heterogeneous agents have been developed.
In the following section, we briefly discuss the processes of forming inflation expectations among economic agents, as well as their implications, based on the empirical evidence provided by the literature. In section 3, we present an overview and assessment of the available measures of inflation expectations in the euro area. The next section describes the recent developments in euro area wages and evaluates the potential impact on inflationary expectations. The last section concludes.
2. INFLATION EXPECTATIONS: WHAT MATTERS TO WHOM?

In real life, the factors that drive households’ and firms’ expectations are different from those of financial market participants, as well as professional forecasters.

As Coibion et al. (2020b) documents, opposite to investors, households and firms are less attentive to macroeconomic trends and monetary policy stance, especially in a prolonged period of low inflation. Their expectations are more backward-looking and can be shaped by inflation-related information they receive through the media. Individual expectations can be also influenced by their daily shopping experiences, in general or when purchasing specific goods and products (Kumar et al., 2015; Cavallo et al., 2017; D’Acunto et al., 2018). Households’ inflation expectations are particularly influenced by price changes in frequently purchased goods (such as groceries or fuel), creating a “veil of inattention” with respect to aggregate inflation and monetary policy announcements. For example, D’Acunto et al. (2018) present an analysis suggesting that high expectations are driven by the members of households who do the main grocery shopping. Dispersions in personal opinions about future inflation can be also driven by demographic and socio-economic characteristics (Easaw et al., 2013; Conrad et al., 2021).

For firms, especially for small companies or for those belonging to a specific sector, the price of specific production inputs (e.g. energy or commodities) may be particularly relevant in affecting the production costs and strongly affect expectations about future price dynamics. In the current context, energy prices may play such role.

Rising inflationary expectations have different implications on the behaviour of households, firms and financial market participants. As theoretical models, as well as some empirical evidence, suggest, households with higher inflation expectations are more likely to raise their current spending, especially on durable goods (D’Acunto et al., 2015; Duca et al. 2016). As they see their purchasing power being at risk, households are also likely to expect unions to negotiate higher wages. Inflation expectations also affect firms’ economic behaviour and, in turn, prices, capital investment and employment (Coibion et al., 2020a). Finally, higher inflation expectations pose risks to investors due to a reduction in expected real returns on financial assets, that also affect asset allocation.

Importantly, different prices, which are captured by different indicators are relevant to the different groups. For consumers, and households in general, the consumer price index, the harmonised index of consumer prices (HICP) in the euro area, is clearly the most important indicator. For firms, the GDP deflator, which captures the changes in prices of everything produced in an economy, should be the most relevant. For financial markets participants, inflation expectations are captured by the term premium that is applied on bonds, as this is what will compensate for potential loss in yields in the case of inflation rises (see Box 1).
Box 1: When HICP and the GDP deflator diverge

According to the argument illustrated above, different indicators of inflation, HICP and the GDP deflator, are likely to be relevant to households and companies, respectively, and affect their behaviour. Historically, the euro area GDP deflator and core HICP had been moving closely together up until 2010. It is with the financial crisis that behaviours started to diverge (see Figure 2). This lasted until around 2013, then the deviation declined. In 2018, trends started to diverge again but unlike during the financial crisis, the GDP deflator signalled a higher inflation rate than the HICP. With the outbreak of COVID-19, the increased volatility in the two indicators has made it difficult to identify a clear pattern, but in several quarters when the two indicators move closely together, the magnitude of the changes is very different (the GDP deflator exhibits much larger changes).

Figure 2: Price developments in the euro area (annual rate of change)

Interestingly, around 2010, core HICP was pointing to higher inflation than the GDP deflator, after 2017 the opposite became true. A legitimate question relates to the implications, if any, of the divergent behaviour of the two measures on actual inflation. To what extent, and how, are inflation expectations likely to be affected? To what extent should the central bank, which targets the HICP, also monitor or consider GDP deflator developments in its inflation expectation formation? Similar considerations also apply to social partners: to what extent do the pattern differences of the two indicators impact the wage bargaining process and the outcome of negotiations.

Source: Authors’ own elaboration based on Eurostat and FRED data.
3. MEASUREMENT OF INFLATION EXPECTATIONS

Inflation expectations are tracked through survey-based and market-based measures. Measures of expectations based on surveys capture the assessments made by consumers and businesses on inflation and the degree of their uncertainty about price developments. In comparison, market-based indicators reflect the investors’ perceptions of potential inflation risks (often at country level) and are measured through a term premium.

Among the surveys-based metric, special attention is given to the Survey of Professional Forecasters (SPF). This survey is based on the inflation projections, over the short- and long-term horizon, provided by financial or non-financial institutions experts, based within the European Union (EU) (Garcia, 2003). This indicator is particularly relevant to the ECB, and in general to central banks, to form inflation expectations.

According to the ECB SPF, in the last quarter of 2021, long-term (for 2025) inflation expectations in the euro area were at 1.9 %, and the short- and medium-term at around 1.7 %, the same levels as in 2018, which shows a stabilisation after a sharp decline over 2020. Among them, the short-term measure is seen to have moved most closely with actual headline inflation, whereas the longer-term metric appears rather steady and associated the least with actual inflation (Figure 3).

Figure 3: Survey of Professional Forecasts: inflation expectations vs. actual inflation (Percentage changes per annum)

Beside the point estimates of inflation expectations, the ECB calculates the probability distributions (at different time horizons), which capture the heterogeneity of survey respondents’ expectations and offer measures of uncertainty and balance of risks related to possible inflation outcomes. The uncertainty is measured as the average standard deviation of the individual distributions, whereas the risk is estimated as average individual distribution asymmetries. Figure 5 suggests higher uncertainty, which increased at the onset of the pandemic, and persistent downward risks to central expectations since the financial crisis. Even though, since 2016 the trend in the balance has changed, it remains negative and with increased variations.
From a policy perspective, raising uncertainty and risk around these expectations tend to make the SPF a less reliable source of inflation expectation in monetary policy setting. Market-based inflation expectations are usually measured through estimates of the term premium, and its components, on sovereign bonds yields or swaps rates. Inflation swaps are simple contracts whose payoff is directly linked to the actual future inflation rate (the HICP for euro area inflation swaps). These swaps exist for many maturities, including from one to 10 years. From this term structure of inflation swap prices, one can also derive expectations about future inflation. For example, the difference between the 10-year rate and the five-year rate should (under certain conditions) be equal to the inflation rate expected in five years, for the following five years (the so-called “5years/5years” rate). Figure 4 below provides an illustration of the calculation made by the ECB for the euro area using inflation-linked swaps. It shows that the risk premium component comprises a major part of the recent developments in inflation expectations (Lane, 2021).

Source: ECB (2021a) Chart 5 – based on ECB (SPF) and Eurosystem staff calculations.

Figure 5: Euro area 5y5y inflation-linked swap rate and the inflation risk premium (Percentages per annum; percentages)

Source: Lane (2021), Chart 8.
A recent analysis from the De Nederlandsche Bank (2021) has used this approach to look at the 1year/1year ahead inflation expectations to find out whether next year’s inflation will return to the ECB’s target.

Another example of market-based inflation expectations is given by the so-called “break-even” inflation rate. This is defined as the differential between a long-term nominal bond yield and the real yield available on an index-linked bond of the same maturity. This is the rate of inflation under which the expected nominal return to an investor will be the same, regardless of whether the investment is made in a fixed nominal income or an index-linked bond. In practice the break-even inflation rate is not a direct measure of inflation expectations as it also contains a premium against the volatility of inflation and the lower level of liquidity. Figure 6 provides an illustration of such a proxy of inflation expectations, based on French Treasury bonds (the difference between the Obligation assimilable du Trésor [OAT] and OAT€i, namely OAT indexed to the euro-area consumer price index). The French government has issued some of these bonds with a 2030 maturity. One can then obtain an estimate of the rate of inflation which bondholders expect by comparing the return on indexed and non-indexed bonds (of the same maturity and otherwise similar conditions). The chart suggests a convergence of expectations around 1.9% in late 2021, and then a decline at the end of the year, after a substantial increase following the outbreak of the pandemic.

Figure 6: Breakeven inflation, euro area


Note: (1) the difference between the yield of the OAT 2.50%, May 2030 and the yield of the OAT€i 0.7%, July 2030. (2) the difference between the yield of the OAT 2%, May 2048 and the yield of the OAT€i 0.1%, July 2047.

Lastly, households’ inflation expectations are the most difficult to capture, and potentially the least reliable. In the EU, a survey exists and measures the balance between upward and downward expectations compared to current circumstances, instead of numerical expectations.
Figure 7: Consumer (1 year ahead) inflation expectations vs. actual inflation.
(Percentage changes per annum)

Source: Eurostat data.

Note: The balance indicates the gap between a share of respondents who expect prices to “increase” and those who expect them to “decrease”. Data is seasonally adjusted.

Figure 7 compares the balance of the responses with actual HICP. It clearly shows a co-movement of consumers’ short-term inflation expectations with actual HICP inflation (measured over the preceding 12 months). The correlation coefficient between the two measures is found to be around 0.79 over the sample period. We also found that consumer expectations are more weakly correlated with core inflation (correlation coefficient about 0.57), indicating the influence of energy and food prices on consumers’ perceptions of future prices, something that is not observed in the expectations of professional forecasters. Indeed, the latter is found to be slightly more linked to core inflation than to headline inflation for medium and long-term measures.

This tight correlation between consumer expectations for inflation one year ahead and actual inflation over the previous year suggests that consumer expectations tend to be myopic – highly correlated with past observation – and are unlikely to constitute a good predictor of actual inflation. This is line with the findings of the literature, mentioned in section 2, pointing to consumer expectations being affected by the current prices of goods that they frequently consume.

The available data on consumer inflation expectations has the further disadvantage that the survey results only give the balance between those expecting prices to increase over the next year and those who do not expect this to happen. In practice, this provides little information on the expected average rate of inflation, since those expecting an increase might fear a large increase whereas those expecting a fall in prices might have in mind a rather limited fall. For these two sets of reasons, consumer surveys are usually not used in economic models, nor do they formally enter the inflation forecasts of the ECB, though they are monitored, nonetheless.

Overall, no perfect measure of inflation expectation exists. On the contrary, all of the ones available seem to have important shortcomings. However, inflation expectations do have an impact on the behaviour of economic agents and can work as magnifiers of current inflation developments. For these reasons they need to be monitored and, for many central banks with inflation targeting strategy, anchoring inflation expectations is seen as an important tool to achieve their objective.
4. HEADING TOWARDS A WAGE-PRICE SPIRAL?

Against the background of which inflation expectations matter, to whom, and how to measure them, an important question is about how inflation expectations affect actual inflation and could amplify current dynamics. As highlighted in the introduction, inflation expectations are part of several transmission channels. However, the most influential and the one with a potentially more persistent effect is likely to be the wage setting. Higher persistent inflation expected by workers will likely make them demand an adjustment in nominal wages during wage negotiations, to compensate their expected loss of purchasing power. If they achieve this, it will raise labour costs and cause firms to increase their prices, which, in turn, would lead to another demand by workers for a pay rise, and thus a loop of consistent price increases would be set into motion.

In the current situation, where both HICP and the GDP deflator are raising, it is crucial to understand whether such trends will be incorporated in wage setting, and could make current inflation dynamics persistent. According to the data, this does not seem to be the case, at least for the time being.

4.1. Wage developments in the euro area

Wages represent another case of a large discrepancy between a simple concept in macroeconomic models and the multiple measures available to policymakers. In practice, wages can be measured in many different forms, for example as negotiated wage (increases), hourly wages actually paid, employee compensation (per week or month), wage costs to employers, etc. In addition, the widespread use of short-term work schemes since the start of the pandemic makes it even more difficult to find a single, representative measure of wages. Moreover, recent data is distorted by the unprecedented fall in employment and compensation per employee in Q2 2020, which was then followed by a sharp rebound in early 2021 (see Figure 8).

Figure 8: Compensation per employee and headline inflation in the euro area
(Annual rate of change)

Source: Authors’ own elaboration based on Eurostat and ECB data.

Unit labour costs moved opposite to wages in early 2020, with spikes in opposite directions in Q2. The first leg of output recovery allowed unit labour costs to greatly decelerate, but the growth rate
remained even in Q2 2021, at 4 % higher than before the pandemic. By contrast, wages (as measured by compensation per employee) were increasing to their pre-pandemic rate by early 2021.

Another problem with wage or labour cost measures is that they are available only with a rather long lag. The available data thus pre-dates the very recent surge in HICP inflation.

Several empirical studies document that the pass-through from labour costs to inflation in many European economies has diminished since the global financial crisis (Bobeica et al., 2019; Boranova, 2021). This coupled with recent observations of wage developments in the euro area do not imply the potential for inflationary pressures.

Figure 9: Compensation per employee and negotiated wage rates in the euro area

(Annual rate of change)

Source: Authors’ own elaboration based on ECB data.

Note: Compensation per employee is calendar and seasonally adjusted. Indicator of negotiated wage rates is neither calendar nor seasonally adjusted.

Koester and Grapow (2021) examine the wage adjustment mechanisms in the private sector in the euro area. According to their analysis, only a marginal fraction of private sector employees (3%) indexes their wages to inflation. Also, 18 % of employees consider inflation developments during wage negotiations, based on mainly forward-looking inflation measures, excluding energy prices. These results suggest a negligible direct impact of inflation, as well as energy inflation on wage setting in the euro area.

Figure 10 illustrates the development of negotiated wages and core inflation, in comparison with the evolution of consumer-based inflation expectations in the euro area. The figure indicates, except during the 2008 financial crisis, only a weak link between inflation expectations and negotiated wage rates. The latter is observed to have moved rather closely with core inflation, although the pattern seems to have altered during the COVID-19 crisis.
Figure 10: Negotiated wage rates, consumer inflation expectations and actual inflation in the euro area

Source: Authors’ own elaboration based on Eurostat and ECB data.
5. CONCLUSION

Inflation expectations matter and are important to be monitored, as economic agents and financial markets act on their expectations of future price increases. However, the way expectations are formed in practice, and the determining factors, differ across agents.

We found that the data from consumer surveys has little predictive power. Consumers tend to expect more price increases in future when they see prices rising today. The surveys from professional forecasters, used by the ECB, seem to be less influenced by actual inflation. But the long-term inflation rates expected by professional forecasters have remained above the medium- and short-term rates for the last 12 years.

In many models, wages represent the element that transforms inflation expectations into higher actual inflation. However, we found little evidence that such a mechanism has been important for the euro area over the last decade (of low inflation).

The currently available measures of inflation expectations do not correspond to the inflation expectations which form a central part of the macroeconomic models used by central banks (including the ECB). Also, neither the professional forecasters, nor consumers, have anticipated the current surge in inflation that Europe is experiencing. They can provide some useful additional input in policy decisions, but the ECB should not try to target them directly.

Finally, central banks’ communication often addresses the expectations of financial market participants rather than those of households and firms. The communication strategies adopted by most central banks since the 1990s have largely been effective in anchoring the long-run inflation expectations of financial markets in advanced economies (Coibion et al., 2020b). In a forward-looking perspective, a fundamental question is whether recent, and quite abrupt changes, in inflation represent a risk of de-anchoring expectations. The SPF does not seem to suggest so, but it is too early to say whether this is the case.
REFERENCES


Inflation expectations are key inputs into monetary policy, but they also represent one of the most difficult variables to measure. Inflation expectations are particularly difficult to pin down in a low inflation environment in which important relative prices experience large changes. The available measures of inflation expectations differ widely across different sources and could be used at most as an additional element in monetary policy decisions, but not as a target.

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